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PRELIMINARY RESULTS
GILT EDGE DISTRICT MAPPING
AND
GENERATIVE EXPLORATION PROJECT
LAWRENCE COUNTY, SOUTH DAKOTA

NOVEMBER 1987 - AUGUST 1988

REPORT PREPARED FOR

BROHM MINING CO.

DEADWOOD, SOUTH DAKOTA

BY

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SEPTEMBER 1, 1988

CONTENTS

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This report summarizes preliminary results of geologic mapping and generative exploration carried out on Brohm Mining Co. properties in the Gilt Edge district in 1987-1983. A set of geologic maps at scale of 200 feet to the inch and a compilation at 500 feet to the inch have been produced.

Bulk tonnage, gold mineralization at Gilt Edge is closely associated with emplacement and evolution of an akalic hypabyssal igneous complex. Gold-bearing hydrothermal ore fluids are orthomagmatic and evolved from crystallization of a sulfide-bearing trachyte (latite) porphyry. Ore fluids continued to circulate during emplacement of slightly younger quartz eye trachyte porphyries. Mineralization was emplaced in structures and reactive host rocks. Favorable locations for disseminated ores are: tabular breccia zones and fractured wallrocks at margins of the quartz eye trachyte porphyry plugs, quartzite units of the lower member and carbonate-rich units in the middle member of the Deadwood formation; and along the margins of steep faults and fissures that serve as hydrothermal conduits.

Principal additions to ore reserves at Gilt Edge will come from systematic exploration and development drilling beneath the leach pad and plant site, and on the southeast margin of Anchor Hill.

A second potentially ore-bearing igneous-hydrothermal center is identified west of Two Bit Gulch in the west 1/2 of section 36 and north 1/2 of section 1. Systematic soil sampling on a grid with analyses for gold and arsenic should be done in this area to help define near surface ore targets. Land acquisition activities in this area should continue.

Quartzite and carbonate units of the Deadwood formation mineralized with gold, sulfides and silica are found at the surface south of the El Refugio mine in the NE 1/4 of section 4. Potential exists for defining one to two million tons of near surface ore in this area. Detailed mapping and sampling of trenches, cuts and outcrops in this area is recommended. Land acquisition should continue.

A speculative low priority target for concealed replacement gold ore is centered in section 6, one to two thousand feet west of Anchor Hill. Weak pervasive hydrothermal alteration, sulfide mineralization and measureable gold values along steep structures suggest favorable host beds of the concealed Deadwood formation may be mineralized. This possible target should be tested when condemnation drilling for the sulfide project plant site is done in this area.

Detailed mapping at 200 feet to the inch should continue thru the area now mapped at 500 feet to the inch.

INTRODUCTION

A program of geologic mapping, prospecting and evaluation of mineral potential on lands controlled by Brohm Mining Co. in the Gilt Edge District, South Dakota was initiated in November 1987. Principal objectives of this effort are to establish a geologic data base to assist in land acquisition activities and to provide basic information to help plan and interpret data for permitting activities. Another important objective is to identify and evaluate mineralization and define possible ore targets on land controlled by Brohm Mining Co. A third objective is to identify and define principal ore controls and use this information to aid in identification of potential ore targets.

Tom C. Patton carried out part of the mapping activities in November-December 1987. Richard Nielsen carried out the mapping activities in November-December 1987 and May to June 1988. Field data are posted on geologic maps at 1" to 200' and 1" to 500 feet. Geochemical data sheets are attached in an appendix. This report summarizes our principal conclusions and recommendations.

WORK DONE

A geologic map is prepared for the area covered by property controlled by Brohm Mining Co. We attempted to identify and evaluate all mineralization or potential mineralization on the property. Special effort was made to identify and map structures, alteration halo effects to mineralization, and favorble igneous and sedimentary host rocks.

More than 200 rock chip samples of mineralized material were collected and assayed for gold, silver, arsenic, flourine and, in some cases, for copper, lead and zinc.

Geologic mapping done in November and December is posted and compiled on a topographic base at a scale of 500 feet to the inch which is an enlargement of the USGS Deadwood South 7.5' quad map. Mapping completed in May-June 1988 was compiled on a new topographic base at 200 feet to the inch scale prepared March 1988 for Minproc by Intermountain Aerial Surveys of Salt Lake City. One task that remains to be done is compilation of all geologic mapping onto a single topographic base.

Owing to extensive nature of forest and soil cover and general lack of natural outcrops, our geologic maps are designed as outcrop maps and show outcrop control by bright or intense color. Inferred rock types are shown by pale color shading.

Location of all geochemical samples are posted on the 500-scale geologic map or on mylar overlays to the 200-scale geologic maps. Geochemical data collected by AMOCO also are plotted on the overlays. Map coordinates of samples, description of the material and analytical results are attached in an appendix to this report.

PRINCIPAL RESULTS

Precambrian Metamorphic Rocks

Precambrian rocks are not widely exposed in the map area. Extensive outcrops are present near the village of Galena at the mouths of Butcher Gulch and Ruby Gulch. Outcrops also are present along Strawberry Creek in Boomer Gulch, and along the paved highway west of Strawberry Ridge. A small outcrop was mapped near the center of section 31.

Quartz-muscovite biotite schists and amphibolite are the predominant rock types in the Gilt Edge area. A little greenstone is present and a conspicuous banded meta chert in the Hoodoo and Strawberry Creek areas appears to be isoclinally folded.

These Precambrian rocks are not a good host for disseminated gold mineralization. Extensive and widespread mineralization in Cambrian Deadwood formation and trachyte porphyry in the Hoodoo area and in upper Strawberry Creeks dies out in a very short distance within adjacent Precambrian schists. This feature appears confirmed in drill holes where ore grade gold mineralization appears confined to narrow structure-controlled areas within the Precambrian rocks.

The siliceous meta chert appears to be unmineralized. Rock chip samples collected from this unit show no detectable gold values.

Approximately 30 million ounces of gold has been produced from Precambrian rocks at Lead, about four miles west of the Gilt Edtge district. All lode gold produced has come from the carbonate facies iron formation and related rocks of the Archean Homestake formation.

We checked detailed geologic maps of Darton and Paige (1925), Paige (1924) and Noble and others (1949) to determine if the ore bearing horizon at Homestake may lie concealed beneath Tertiary igneous rocks at Gilt Edge.

Regional foliation in the Homestake formation strikes north to north-northwest. It is complexly folded into nappe-like recumbent folds. Most likely projection of the formation into areas where the unit may be concealed by younger rocks is to the north of Lead into the area at the headwaters of City Creek, one to two miles north-northeast of Central City (see attached map).

Chances of Homestake formation being present beneath Tertiary igneous rocks on Brohm property at Gilt Edge are very, very remote. The schists and amphibolites present at Gilt Edge are believed to be part of a completely different Precambrian sequence than that containing the Homestake formation. Precambrian rocks at Gilt Edge are considered to be a relatively young sequence that rests unconformably upon the Homestake formation. I believe that Homestake formation is not present on Brohm property and the interest in the area expressed by Homestake Mining Company is for an exploration play within the Deadwood or Tertiary igneous host rocks.

Cambrian Deadwood Formation

A continuous complete stratigraphic section is not present on the Brohm property. Strata of this formation are highly disturbed and injected by Tertiary igneous sills and dikes.

Based upon work by Darton and Paige (1925) on the type section at Deadwood, modified by Gries (1952), Butler and others (1955) and Mukherjee (1968), the Deadwood formation is about 400 to 500 feet thick and may be divided into three informal members. A lower member consists of hematitic quartz pebble conglomerate and hematitic sandstone overlain by quartzitic sandstone. This lower sandy member is about 40 feet thick and is a host for veinlet or stockworks-type disseminated gold mineralization in the Gilt Edtge area. A middle member consists of sandy shale, buff to gray dolomitic limestones, limestone conglomerates and greenish gray shale. The middle member may be up to 250 feet thick and carbonate layers are host for gold-bearing replacement sulfide mineralization at Gilt Edge. The green-gray shale beds of this member generally shows little alteration or mineralization. An upper sandy member is up to 140 feet thick and consists of well bedded dolomitic sandstone with green shale partings. This unit is host for contact replacement ore at Gilt Edge.

Certain specific stratigraphic horizons are preferred location of Tertiary intrusive sills. The basal contact of the formation is the location of major laccolithic intrusions in the Gilt Edge mine area and in the area west of Two Bit Gulch. Porphyry sills have intruded the dolomitic middle and upper members.

We speculate that rock-types especially suitable for disseminated bulk tonnage gold mineralization are the relatively permeable vuggy hematitic sandstones of the lower sandy member. Hypogene ore fluids entering these beds would be oxidized by relatively oxidized formation waters in chemical equilibrium with hematite and destabilize the Au-bisulfide complex, precipitating gold. Exploration drilling by Utah International in the Spruce Gulch area 1986 showed favorable units for gold mineralization are the lower hematitic quartz sandstone and upper dolomitic sandstone units.

Ordivician Sediments

A relatively thin, 10-15 foot thick bed of scolithus sandstone is mapped in the SW 1/4 of section 35 where it is overlain by 60 to 70 feet of greenish gray, thinly laminated shale. These two units are considered to be the Ordivician units.

These units may also be present on Bear Den Mountain in section 33. The Cambrian Deadwood formation in this area is mapped as 500 feet thick. Part of this apparent anomalous and excessive thickness probably is the Ordivician formations. Outcrops are rare on forest-covered Bear Den Mountain and we did not recognize the Ordivician units here.

The scolithus sandstone west of Two Bit Gulch in the northwest corner of the map area is mineralized and altered. Rock chip samples gave 0.023 opt gold. The overlying Ordivician shale is unaltered and unmineralized.

Mississippian Pahasapa Formation

Buff domomitic limestone of the Ordivician Englewood limestone was not differentiated from the buff to gray limestones of the Pahasapa formation. Both units probably are present in the limestones at the crest of Bear Den Mountain. Both units are unmineralized in the map area.

Tertiary Gilt Edge Igneous Complex

Gold mineralization is closely associated with evolution and emplacement of the alkalic hypabyssal intrusions of the complex. Several pulses of intrusions are represented and hydrothermal emplacement of gold mineralization occurred late in the sequence.

Igneous activity in the district began with emplacement of hornblende trachyte sills from feeders located north of the Golden Crest mine and west of Anchor Hill. Fault displacements then became active, probably associated with emplacement of viscous polymerized magmas into the Paleozoic sedimentary cover. A complex of dikes and plugs of coarsely porphyritic trachyte porphyry was emplaced north of the Gilt Edge area, centered on vents in the Dome Mountain area. Two volatile-rich laccolithic quartz-bearing trachyte porphyry plutons next were emplaced. One is centered in the Gilt Edge mine area, the other in the headwaters of Spruce Gulch, north of Monarch mine. Emplacement of laccoliths was followed closely by intrusion of related quartz-rich quartz trachyte porphyry plugs and associated breccias in the Gilt Edge area and near the Monarch mine. Hydrothermal introduction of gold mineralization overlaps the last two igneous events. The final major igneous event was extrusion of an aphyric rhyolite flow in the Butcher and Ruby Gulch area.

Further details on each igneous event are given below.

Hornblende Trachyte Porphyry Sills. This unit is exposed throughout the map area and is the most widespread igneous rock of the Gilt Edge igneous complex. We recognize that several individual sills and one or two composite layered sills are present and all have been lumped together into a single map unit. Thin sills generally are porphyritic aphanitic with sparse hornblende phenocrysts in a fine gray aphantiic matrix. Relatively thick sills are porphyritic micrograniti c with prominent hornblende phenocrysts and/or prominent feldspar phenocrysts in fine granular matrix. The point is that a group of multiple intrusive sills are represented by the map unit and all are roughly the same composition. That composition probably is trachyandesitic. The injected magma was fluid and spread out as sills over a large area. These widespread sills are mapped as hornblende diorite porphyry by Mukherjee (1968).

Several layers or strata in the Deadwood formation are favored as locations for sills. Most sills are emplaced in the middle member of the Deadwood, usually above the lower quartzite and at various levels within the middle member. At least one or two sills are emplaced in the upper dolomitic sandstone member of the Deadwood formation.

Hornblende trachyte porphyry sills attain greatest aggregate thickness west of Anchor Hill and north of Golden Crest mine in section 6. We infer the feeders for the sills are in this area. Indeed, we mapped three small plugs or stocks of equigranular fine-grained syenodiorite in this area and we infer these plugs fill the feeder vents for the sills. One plug is located about 2000 feet north of the Golden Crest mine in the NW 1/4, SW 1/4 of section 6, one other is located about 3000 feet north-northeast of the Golden Crest mine near the center of section 6, and a third is located 800 feet east of Anchor Hill. These intrusions are mapped as pyroxene diorite and pyroxene andesite porphyry by Mukherjee (1968).

The sills are commonly altered and weakly mineralized adjacent to fault structures and prevasively altered in and around the Gilt Edge mineralized system. This alteration is of a propylitic type and is manifest by replacement of hornblende by chlorite and pyrite. The groundmass is bleached and contains a little carbonate, clay and sericite. In weathered outcrops the chlorite is argillized and the groundmass is bleached and fractures are coated with goethite. This rock becomes slightly bleached, pyritized and altered to clay, sericite and possibly alunite in the strongly mineralized zone in and around the Gilt Edge ore bodies.

Mukherjee reports an age date of 60.5 m.y. on relatively fresh hornblende diorite porphyry. This age date places a maximum age on the emplacement of mineralization.

Trachyte Porphyry. This is a field name for strikingly porphyritic dikes and small plugs that are widespread in the northern part of the map area. These small intrusions are particularly abundant north of the Gilt Edge mineralized area, west of Lost Gulch and east of Two Bit Gulch. Particularly large plugs are located on Dome Mountain and in the NE 1/4 of section 31.

Trachyte porphyry generally is unaltered and unmineralized and forms prominent massive to blocky outcrops. Tracing these outcrops, one can clearly show that this rock is present as dikes and plugs intruding either Cambrian Deadwood formation or hornblende trachyte porphyry sills.

A conspicuous feature of trachyte porphyry is large tabular K feldspar phenocrysts, commonly one to three centimeters long. These are set in a granular matrix of hornblende and feldspar. I have trouble using the name "trachyte porphyry" for this rock. In most outcrops the name "hornblende syenite porphyry" is more appropriate owing to granular phaneritic nature of the groundmass. The term "trachyte porphyry" is retained to conform with my understanding of terms used at the mine.

Trachyte porphyry (hornblende syenite porphyry) dikes and plugs generally are unaltered and unmineralized. Outcrops of this rock do show some alteration near the head of Ruby Gulch where they lie within the halo of alteration associated with the Gilt Edge mineralization. This alteration is shown by bleaching with clay carbonate alteration of groundmass.

Mukherjee (1968) maps describe this rock as hornblende monzonite porphyry and recognizes the complex geometry of intrusive relations.

Hornblende Dacite Porphyry/Trachyte Porphyry/Latite Porphyry. Here we encounter problems in rock terminology owing to the altered and mineralized nature of this rock type in the area of exposure. Trachyte porphyry, a mine term, is the principal host rock for disseminated gold mineralization in the mine area. Here this igneous rock unit intrudes in laccolith-like fashion along the Precambrian-Cambrian boundary and is intruded by plugs of quartz trachyte porphyry. West of Two Bit Gulch hornblende dacite porphyry forms a laccolith-like intrusion and sills.

This rock type rarely is unaltered. It consists of hornblende, plagioclase and K feldspar phenorcrysts in fine granular to aphanitic matrix. Small quartz phenocrysts are sparsely present. Generally disseminated sulfides are present in vugs and clots in the groundmass. Hornblende dacite porphyry west of Two Bit Gulch contains vugs and cavities containing sulfides, mainly pyrite with minor chalcopyrite. The sulfides appear to have an orthomagmatic origin.

A dike of altered and mineralized intrusive rock extending from the Hoodoo area east-southeastward to Bear Butte Creek was originally mapped as "quartz trachyte porphyry" in the Fall of 1987. Further mapping in 1988 indicates this dike-like body probably is continuous with an part of the intrusive mass mapped as trachyte porphyry in the mine area. It is not the same as the quartz trachyte porphyry of the Rattlesnake or Anchor Hill porphyries.

This rock was mapped and described as "latite porphyry" by Mukherjee (1968). Unfortunately, he does not differentiate it from the intrusive porphyries with the large prominent quartz phenocrysts - an important distinction.

Widespread alteration in this rock in the Spruch Gulch-Two Bit Gulch area and east of Hoodoo is best described as pervasive propylitic alteration. Hornblende has been altered to chlorite or sericite. Feldspars are replaced by albite with sericite and carbonate. Usually K feldspar is unaltered. The groundmass is bleached and contains sericite, clay and carbonate. Pyrite and chalcopyrite or their weathered equivalents are present in vugs and mirolitic cavities.

This rock is very strongly altered in the Gilt Edge ore zone where it consists of clay sericite, alunite and limonites.

In summary, the essential features of this rock type are that is is a quartz-bearing porphyritic rock of quartz latite to dacite composition, it is dike-like or laccolithic in its intrusive form, it carries disseminated sulfides and hydrothermal alteration of varying degrees of intensity that appears orthomagmatic in origin. It is intruded by pipes or plugs of quartz-eye quartz trachyte porphyry, and most important, it is closely associated with gold mineralization (either vein, contact replacement or disseminated).

Quartz Trachyte Porphyry/Quartz-eye Rhyolite Porphyry. This rock occurs as relatively small stocks and plugs in the Gilt Edge mine area and near the Mary mine and about 2000 feet north of the Monarch mine in the SW 1/4 of section 36. The stocks commonly intrude quartz latite or dacite laccoliths, Precambrian schists, Cambrian Deadwood or Tertiary hornblende trachyte porphyry. Mineralized hydrothermal breccias commonly occur along the margins of the plugs and the porphyry itself generally has a protoclastic - almost tuffaceous texture. Commonly quartz trachyte porphyry is pale gray or pale cream, leucocratic with prominent K feldspar and quartz phenocrysts. The quartz phenocrysts are relatively large bipyramidal skeletal quartz "eyes". Although these porphyries are found close to ore, they do not serve as hosts for extensive disseminated gold mineralization. This rock type comprises the Rattlesnake, Dakota Maid and Anchor Hill stocks.

Emplacement of these quartz trachyte porphyry plugs probably was accompanied by a dramatic and explosive explusion of magmatic volatile fluids but most hydrothermal mineralization ended up in the contact zones around the plugs.

Rhyolite Felsite. This unit is exposed on ridges and walls adjacent to Butcher Gulch and Ruby Gulch, mainly in the NW 1/4 of section 4. It largely is a fine-grained massive aphyric pale buff to cream-colored porcellaneous felsite. It has abundant fractures and weathers to blocky fragments with weak limonite coatings. Faintly developed banding owing to slightly differing grain size probably reflects flow banding. Felsite rests upon Precambrian schists and mineralized Deadwood quartzite. A monitor drill hole located in the NE 1/4, NW 1/4 section 5, passes thru felsite and ended in altered quartzite of the Deadwood formation. This suggests felsite was emplaced on an erosion surface developed across Precambrian and Deadwood formation. We mapped apparent intrusions of hornblende trachyte porphyry into felsite which, if true, would indicate felsite is the earliest igneous rock in the Tertiary sequence. No significant mineralization is found in the felsite. Mukherjee (1968) mapped this unit as rhyolite. He interpreted the northeast trending outcrops of rhyolite near the center of section 4 as dikes of rhyolite intrusive into hornblende trachyte sills. The relationships are ambiguous and could go either way. I think we have to entertain the possibility that rhyolite may be the youngest igneous rock in the igneous sequence and may be post-mineral.

I interpret the felsite as a rhyolitic lava flow or flow-dome complex, probably emplaced as a glassy flow and later devitrified to felsite. Intense fracturing in the unit partly reflects a reaction to volume change accompanying devitrification.

Structural Features

Igneous rocks and mineralization in the area are emplaced into a generally flat-lying or gently-dipping section of Paleozoic sedimentary rocks lying unconformably upon highly deformed Precambrian metamorphic rocks. The general regional dip of the superjacent sediments is gently north and reflects the northerly regional dip off the Black Hills uplift. Local changes in direction and amount of dip reflect doming away from centers of intrusive activity.

One important result of our mapping was definition of faults and structure trends that guided emplacement of dikes and plugs. Definition and careful mapping of specific hornblende trachyte sills allows us to define displacements across the faults.

Principal fault direction in the northwest part of map area is north-south and is reflected by faults along Two Bit Gulch.

This trend changes direction to southeast towards the south and east. South-southeast fault trends are evident at the Mary mine, Monarch mine and Golden Crest mine. These southeast trends extend into the Gilt Edge mine area.

A prominent northeast structure trend is evident between the Gilt Edge mine and Lost Gulch. The Rattlesnake shear zone in the mine area follows this trend. North of the mine area, dikes of trachyte porphyry and hornblende syenite porphyry follow this trend. The northwest margin of the rhyolite felsite body also follow this northeast trend.

Another significant structural trend that passes thru Gilt Edge is a west-northwest trend followed by dikes and faults. This trend evidently follows foliation in the underlying Precambrian schists.

In summary, structure in the Gilt Edge mine area seems to be dominated by steep fractures and faults with three prominent directions: west-northwest, northwest and northeast. These directions, where followed by faults, show offsets in the hornblende trachyte porphyry sills. Some intrusive bodies follow or intrude along these directions. Very likely much of the development and displacement on these structures occurred during evoluation of the Gilt Edge igneous complex. In other words, they are of Laramide age.

Mineralization Features

Gold mineralization in the Gilt Edge area is closely associated with development and evolution of the Gilt Edge igneous complex. Host rock types and structure serve to localize ore grade mineralization and these ore controls are summarized below. In a general sense, the mineralized system may be classed as disseminated gold mineralization associated with an alkalic hypabyssal igneous rock complex. Mineralization shows features of the both mesothermal and epithermal ore forming environment. Mineralized breccia pipes, orthomagmatic disseminations of sulfide minerals in igneous rocks and replacement mineralization in calcareous sedimentary units near hypabyssal intrusions are features characteristic of a mesothermal environment. Gold-bearing chalcedonic veins, siliceous jasperoid alteration, hydrothermal breccia bodies and close association of mercury and arsenic with strong gold values are typical of the epithermal environment. My feeling is the gold mineralization is best classed as high level orthomagmatic mesothermal mineralization transitional to epithermal.

Ore Controls. Some of the geologic features tht control the distribution, geometry, and size of the ore grade gold mineralization are reviewed and discussed below.

1. A principal control for disseminated gold mineralization at Gilt Edge is the brecciated wall rocks at the margins of the quartz trachyte porphyry plugs and stocks. These hydrothermal breccia bodies seem to have been a zone where hydrothermal boiling was focused. Mineralization is localized in the breccia bodies and in adjacent fractured wall rocks.

2. The igneous rock unit variously mapped as trachyte porphyry (McLeod), latite porphyry (Mukherjee) or dacite porphyry (Nielsen), is a preferred host for disseminated sulfide mineralization. These hypabyssal plutons appear to be laccolithic in intrusive geometry and appear to contain orthomagmatic sulfides and pervasive alteration. An intrusion of this rock type is an important ore host in the Gilt Edge mine area.

3. The basal quartzite member of the Cambrian Deadwood formation appears to be a favorable host for tabular stratabound disseminated and veinlet gold mineralization, especially near high angle structures. I speculate that permeable nature of the unit and presence of hematite matrix creates a situation within the rock unit in which oxidized formation waters in equilibrium with hematite matrix react with reduced hydrothermal ore fluids. The reaction destabilizes the gold-bisulfide complex and precipitates gold.

4. Dolomitic or calcareous sedimentary units within the Cambrian Deadwood formation are favorable hosts for contact replacement sulfide-rich tactites and massive sulfide replacement deposits, mainly along igneous contacts or adjacent to hydrothermal fissures.

5. Steep north-northeast and northwest fractures and faults serve to channel hydrothermal fluids and access favorable stratigraphic units and in this manner control the location of replacement mineralization and fissure or vein mineralization. Thin fractures or faults are the principal ore controls at Golden Crest and Monarch mines and other mines away from the Gilt Edge center.

Features unfavorable for locallizing disseminated gold mineralization include Precambrian host rocks. A little fissure or vein mineralization is present in Precambrian schists, but pervasive mineralization is rare. Shale units within the Deadwood formation are poor hosts for mineralization, possibly owing to their relatively impermeable nature. Hornblende trachyte porphyry sills are another poor host for mineralization. A small volume of disseminated mineralization may lie within this rock type close into the center of the Gilt Edge mineralized system but they are relatively poor hosts for major bulk tonnage ore.

Alteration Features

Gold mineralization at Gilt Edge is associated with abundant amounts of pyrite and relatively sparse amounts of secondary silica. Consequently, alteration associated with ore is characterized by strong pyritization and the strong hypogene acid-leaching associated with strong pyrite mineralization.

We attempt to distinguish two degrees of alteration in our field mapping. An area of strong alteration is closely associated with the gold ore zone at Gilt Edge and shown by a yellow outline on our 200 scale map. Within this area the igneous rocks are strongly bleached and replaced by clay, sericite and alunite. Deadwood quartzite and carbonates are strongly mineralized with pyrite; siltstones are rich in pyrite and are bleached and replaced by clay and sericite. Precambrian schists are altered to a mixture of quartz, sericite, pyrite and clay. Jarosite is a common limonite in the weathering zone owing to high pyrite content.

This very strong alteration also is found along structures, accompanied by anomalous gold values, throughout the map area.

A relatively weak pervasive alteration is classed as propylitic in the field and shown by a pale green color on our maps. Igneous rocks may be either bleached to a pale buff color (in weathered zone) or may acquire a greenish color when unweathered. Hornblende is altered to chlorite, plagioclase is replaced by a mixture of carbonate, clay and albite; charbonate is present in the groundmass. In some areas pyrite is weakly disseminated through the rock and along fractures.

Quartzite and sandstone of the Deadwood formation in this propylitic zone may be bleached and usually contain a little pyrite. Calcareous or dolomitic siltstones usually are converted to a mixture of carbonate, actinolite, diopside, silica and a little pyrite (Deadwood hornfels). Carbonate units may be recrystallized. Gold values may be present in detectable amounts in altered Deadwood sediments in this zone.

Weathered rocks of the propylitic alteration zone may show bleaching and contain a capping of geothitic limonites.

Some of this relatively weak alteration may be deuteric in its origin rather than related to the center of gold mineralization.

POTENTIAL ORE TARGETS

Anchor Hill

The Anchor Hill stock consists of quartz "eye" trachyte porphyry and intrudes hornblende trachyte porphyry sills at the present erosion surface. Wall rocks at the southeast margin are not well exposed but float and soil composition suggest that hornblende trachyte porphyry around the southeast margin has very strong argillic alteration. If true, this suggests the underlying Cambrian Deadwood should be strongly altered and mineralized. The south and east margins of the Anchor Hill stock is the place to drill to encounter mineralized Deadwood.

Golden Crest Mine

This old mine lies in the SW 1/4 of section 6 and is developed on a northwest structure with workings present for an inferred strike distance of about 1500 feet. Old records indicate mine development is located only southeast of the old main shaft. Distribution of old workings suggest that ore is localized in sediments of the Cambrian Deadwood formation. Old records suggest ore lies along the structure and is vein-like with widths up to 14 feet, and give an estimated reserve of 375,000 tons of ore at $8.00 or 0.4 opt gold (at $20.00 per oz. Au). Making some assumptions the data suggest this so-called ore body may be a near-vertical tabular body 1500 feet along strike, 14 feet wide and 200 feet vertical distance in the Cambrian Deadwood formation. We find no tailings at the millsite so very likely little or no ore was processed at the site but some may have been shipped directly to toll mills in Deadwood. Our sampling and mapping along the structure indicates that ore grade mineralization is narrow and lies in Deadwood hornfels confined to the narrow structure. I don't see any significant potential for significant tonnage of near surface ore. This mine area could possibly contain +100,000 ounces of recoverable gold in a setting amenable to underground mining. Perhaps at some future date several drill holes to test for ore grade mineralization will be justified.

Monarch Mine

This old mine lies in the NW 1/4 of section 1. It operated intermittently from 1902 to 1936 and produced 7940 tons of direct shipping ore with an average grade of 0.54 opt gold. The mine is developed by several shafts and adits and several thousand feet of underground workings. Limited geologic information suggests that ore grade mineralization is present in patches within dolomite of the lower part of the middle member of the Cambrian Deadwood formation; mineralization lies adjacent to steep north to northwest faults.

An evaluation done in 1984 by Apex Minerals, Inc. included an underground sampling program. Results of this underground work suggests an inplace measured reserve of about 440 tons at a grade of about 0.3 opt gold. Additional small tonnages of probable inplace reserves are estimated. Average thickness of overburden is estimated at 100 feet. Average thickness of ore is 3 feet. Thus, strip ratio of waste to ore is about 30 to 1. Possibility of developing significant tonnages of minable ore is very remote.

Homestake took a look at the possibility of shipping surface waste dumps to Lead. Apex Minerals, Inc. estimates that waste dumps contain 5300 tons at 0.165 opt Au but Homestake took no action on mining. These dumps possibly may constitute a small reserve of material for processing thru the future sulfide plant at Gilt Edge.

Mary Mine Area

The Mary mine is located near the center of section 1. A mill was constructed and now lies in ruins. A few short adits were dug into a few mineralized structures. I can find no evidence that any significant ore was developed or shipped. A little replacement mineralization is present in dolomitic siltstone of the Deadwood formation adjacent to steep north-trending fractures. Our mapping suggests that mineralization at the Mary mine is limited to small pods and zones along structure without any substantial tonnage potential.

Two Bit-Spruce Gulch Area

The area between Spruce Gulch and Two Bit Gulch, namely the west 1/2 of section 36 and north 1/2 of section 6, is underlain by a geologic setting similar to that of the Gilt Edge mine area. A laccolithic intrusion of dacite porphyry has intruded the Cambrian Deadwood formation. Small plugs of quartz-eye trachyte porphyry intrude the dacite and Cambrian Deadwood formation. Our sampling in this area shows that gold mineralization is present along structures and as disseminations and replacement mineralization in quartzite and carbonate units respectively. The north part of this area has been explored with drill holes by Utah International in an effort to find minable replacement mineralization in the Cambrian units. Limited mineralization at the Monarch and Mary mines apparently is related to this center of mineralization.

This Two Bit-Spruce Gulch area has limited outcrop exposure. A soil geochemical survey with analyses for gold and arsenic may be a possible technique to search for and evaluate possible ore target. Homestake's interest in this area undoubtedly is for potential mineralization associated with the Tertiary intrusions. Land acquisition activities in this area should continue.

El Refugio Mine Area

As a result of our regional mapping, an area of limestone replacement mineralization was encountered and mapped south of the Refugio mine in the NE 1/4 of section 4. Dolomitic siltstone of the Cambrian Deadwood formation is injected by a hornblende trachyte sill. Jaspery silicification with pods and blebs of gossanous limonites has extensively replaced carbonate units of the Deadwood. Many pits and trenches have been dug in this area to explore this mineralization.

We collected a few rock chip samples from surface pits and trenches. Gold values up to 0.19 opt were obtained. Assuming a strike length of 2000 feet, a width of 400 feet and a thickness of 20 feet, this area can contain 1.5 million tons of mineralized rock at grass roots.

This area should be mapped and sampled in considerable detail in an effort to define a drill target.

Anchor Hill West

This potential ore target area has poorly defined limits or boundaries but is considered to be several thousand feet across and centered near the center of section 6 about 2000 feet west of Anchor Hill.

This area is underlain by thick hornblende trachyte porphyry sill. Several small plugs of hornblende syenodiorite in this area are probably feeders for the thick sills. We mapped a significant area of propylitic alteration and disseminated pyrite in the sill. This zone of weak alteration and mineralization appears to be 1000 to 2000 feet across. Prospects dug into faults and fractures in this area explore altered and mineralized rock which give anomalous gold values.

Cambrian Deadwood carbonates concealed by the hornblende trachyte porphyry sill should be tested for disseminated replacement mineralization. Condemnation drilling for the sulfide plant site in this area should be designed with holes that penetrate to sufficient depth to test the Cambrian formations.

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	LOCATION	SAMPLE DESCRIPTION	ppb	Ag ppm
2639 (11/21/87 TCP	SW¼, SE¼, Sec. 6 T4N, R4E 746,030 N 1,123,620 E	Rock chip sample from mine dump. Argillically altered Thtp? with jarosite, goethite; some thick gossan after sulfides.	20	0.9
2640 (11/21/87) TCP	NE¼, SW¼, Sec. 6 T4N, R4E 746,610 N 1,122,130 E	Rock chip sample from prospect dump. Argillically altered Thtp. with strong jarosite, goethite and limonite after pyrite.	< 5	1.5
2641 (11/21/87) TCP	SW¼, SE¼, Sec. 6 T4N, R4E 745,940 N 1,123,900 E	Rock chip sample from prospect dump. Argillically altered Thtp with strong limonite.	15	1.4
2642 (11/21/87) TCP	SW¼, SE¼, Sec. 6 T4N, R4E 745,340 N 1,124,450 E	Rock chip sample from prospect dump. Deadwood hornfels, Mn stain, FeOx.	45	3.2
2643 (11/22/87 TCP	Mary Mine SW¼, SE¼, Sec. 1 T4N, R3E 748,210 N 1,119,180 E	Rock chip sample from outcrop of bleached argillized porphyry dike on contact in Cambrian Deadwood sandstone, hematite, goethite jarosite on fract.	130	0.7
2644 (11/23/87) TCP	SW¼, SW¼, Sec. 36 T5N, R3E 751,060 N 1,118,390 E	Rock chip sample from prospect dump. Argillized Thtp with strong jarosite, goethite.	75	0.6
(11/23/87) TCP	747,750 N 1,119,860 E			
2650 (11/23/87) TCP	NE¼, NW¼, Sec. 7 T4N, R4E 744,100 N 1,122,790 E	Rock chip sample from face of 300' adit; Deadwood hornfels.	160	>50

GEOCHEMICAL SAMPLE DATA SHEET

PROJECT: GILT EDGE AREA, MAPPING AND RECON., LAWRENCE COUNTY, SOUTH DAKOTA

Rock Chip Samples collected by T.C. Patton, November - December 1987

SAMPLE NUMBER	LOCATION	SAMPLE DESCRIPTION	Au ppb (oz./ton)	Ag ppm
A (11/87) TCP	NE¼, NE¼, Sec. 12 T4N, R3E 745,090 N 1,120,410 E	Rock chip sample Thtp, FeOx, sampled from N50E structure.	520	> 50
B (11/87) TCP	SE¼, SE¼, Sec. 1 T4N, R3E 746,590 N 1,119,250 E	Rock chips, rhyolite intrusion breccia with strong limonite.	80	3.5
C (11/87) TCP	NW¼, SE¼, Sec. 1 T4N, R3E 747,960 N 1,119,200 E	Rock chips, diorite with disseminated pyrite.	50	1.1
D (11/87) TCP	SW¼, NE¼, Sec. 1 T4N, R3E 749,210 N 1,119,230 E	Rock chip sample, Cambrian Deadwood quartzite, silicified, pyritized - from Two Bit Dump.	15	0.6
E (11/87) TCP	NW¼, SE¼, Sec. 6 T4N, R4E 747,560 N 1,124,170 E	Rock chips, diorite with disseminated and fracture controlled pyrite.	1100 (.032)	1.5
F (11/87) TCP	NE¼, SE¼, Sec. 6 T4N, R4E 747,960 N 1,125,126 E	Rock chips of Thtp - subcrop, goethite - jarosite, minor MnO2.	40	0.9
G (11/87)	SE¼, NE¼, Sec. 6 T4N, R4E 748,130 N	Rock chips, Cambrian Deadwood quartzite, weak limonite.	70	<0.5

GEOCHEMICAL SAMPLE DATA SHEET

PROJECT: GILT EDGE AREA, MAPPING AND RECON., LAWRENCE COUNTY, SOUTH DAKOTA

Rock Chip Samples collected by T.C. Patton, November - December 1987

SAMPLE NUMBER	LOCATION	SAMPLE DESCRIPTION	Au ppb (oz./ton)	Ag ppm
H (11/87) TCP	SE¼, NE¼, Sec. 6 T4N, R4E 748,230 N 1,124,770 E	Rock chips of Thtp, bleached and argillically altered.	50	0.7
I (11/87) TCP	SW¼, NW¼, Sec. 6 T4N, R4E 748,190 N 1,124,380 E	Rock chips of Thtp, argillized, bleached, minor FeOx	40	1.3
J (11/87) TCP	SW¼, SW¼, Sec. 1 T4N, R3E 746,820 N 1,115,510 E	Rock chips of Precambrian phyllite, Cambrian Deadwood quartzite from prospect dump, locally intense limonite.	< 5	0.5
K (11/87) TCP	NE¼, NE¼, Sec. 1 T4N, R3E 750,330 N 1,120,050 E	Rock chips from Cambrian Deadwood hornfels with minor limonites.	5	0.5
L	SW¼, NW¼, Sec. 6 T4N, R4E 748,320 N 1,121,170 E	Rock chips from diorite with 5-10% disseminated and fracture-controlled pyrite.	< 5	1.5
M	NW¼, SW¼, Sec. 8 T4N, R4E 742,060 N 1,127,570 E	Rock chip of Precambrian chert with limonites	< 5	1.2

GEOCHEMICAL SAMPLE DATA SHEET

PROJECT: GILT EDGE AREA, MAPPING AND RECON.

Rock Chip Samples collected by R.L. Nielsen, November - December 1987, April - June 1988

SAMPLE NUMBER	LOCATION	SAMPLE DESCRIPTION	Au ppb (oz./ton)	Ag ppm
2651 (11/22/87)	NW¼, SE¼, Sec. 5 T4N, R4E Upper Ruby Gulch 746,900 N 1,130,010 E	Rock chip sample, natural outcrop; Trachyte porphyry with large blocky K-feldspar in granular matrix; strong propylitic, clay-sericite alteration with goethite and jarosite after sulfides.	5	0.9
2652 (11/22/87)	NW¼, WE¼, Sec. 5 Upper Ruby Gulch 746,920 N 1,129,770 E	Same as above. Former sulfides about 3%.	5	1.1
2653 (11/22/87)	NW¼, SE¼, Sec. 5 T4N, R4E Upper Ruby Gulch 746,580 N 1,129,920 E	Rock chip sample, select high grade from dump of old mine; brecciated and mineralized Deadwood quartzite near contact with Trachyte porphyry, pyrite Ca 5%, partly oxidized.	110 (.003)	1.9
2654 (11/22/87)	Center Sec. 5 Upper Ruby Gulch 747,860 N 1,128,590 E	Rock chip sample from dump of prospect, representative, oxidized sulfide mineralization on fractures in hornblende trachyte and Deadwood hornfels.	240 (.007)	< 0.5
2655 (11/24/87)	SE¼, NE¼, Sec. 4 T4N, R4E ca. 1000 S of E 1 Refugio mine 747,840 N 1,135,840 E	Rock chip sample from road cut; mineralized Deadwood hornfels, gossanous limonites and jaspery silica replacements of calcareous siltite; representative.	5	< 0.5

GEOCHEMICAL SAMPLE DATA SHEET

PROJECT: GILT EDGE AREA, MAPPING AND RECON.

Rock Chip Samples collected by R.L. Nielsen, November - December 1987, April - June 1988

SAMPLE NUMBER	LOCATION	SAMPLE DESCRIPTION	Au ppb (oz./ton)	Ag ppm
2656 (11/24/87)	SW¼, NE¼, Sec. 4 T4N, R4E 748,060 N 1,135,430 E	Rock chip sample from road cut; mineralized Deadwood hornfels, calcareous siltstone with heavy limonites, Mn oxides, some gossan layers, representative sample.	< 5	< 0.5
2657 (11/24/87)	SW¼, NE¼, Sec. 4 T4N, R4E 747,790 N 1,135,280 E	Rock chip sample from road cut in mineralized Deadwood hornfels; calcareous siltstone with heavy limonites, Mn oxides and gossanous layers, representative.	10	< 0.5
2658 (11/24/87)	SW¼, SE¼, Sec. 5 T4N, R4E 745,330 N 1,128,930 E	High grade rock chip sample, dump of adit; oxidized gossanous quartz trachyte porphyry, sheared; moderate to strong bleaching; high sulfides.	190 (.006)	2.3
2659 (11/24/87)	NE¼, NE¼, Sec. 8 T4N, R4E Ridge N of Strawberry Creek 744,530 N 1,129,540 E	Rock chip sample of float near outcrop; oxidized, fractured and mineralized ferruginous Deadwood siltstone; abundant limonites and jasper streaks along beds and in fractures.	< 5	1.2
2660 (11/25/87)	NE¼, NW¼, Sec. 5 T4N, R4E Head of Butcher Gulch 750,010 N 1,128,220 E	Rock chip sample, dump of prospect; oxidized, limonite-stained mineralized Deadwood hornfels near trachyte porphyry contact; gossanous streaks and blebs; representative sample.	130 (.004)	0.8
2661 (11/25/87)	Near center of NE¼, Sec. 5 Upper Butcher Gulch 749,050 N 1,129,830 E	Rock chip sample, dump of prospect adit, high grade sample mineralized Deadwood hornfels along contact with trachyte porphyry; abundant goethite.	1100 (.032)	1.8

GEOCHEMICAL SAMPLE DATA SHEET

PROJECT: GILT EDGE AREA, MAPPING AND RECON.

Rock Chip Samples collected by R.L. Nielsen, November - December 1987, April - June 1988

SAMPLE NUMBER	LOCATION	SAMPLE DESCRIPTION	Au ppb (oz./ton)	Ag ppm
2662 (11/25/87)	NW¼, NE¼, Sec. 5 Head of Butcher Gulch 749,540 N 1,129,370 E	Rock chip sample, dump of prospect, oxidized gossanous mineralization in Deadwood hornfels, streaks of gossan in calc-silicate hornfels, fractured and brecciated near contact with trachyte porphyry.	10	7.5
2663 (11/25/87)	Near center NW¼, Sec. 5 Head of Butcher Gulch 749,470 N 1,127,780 E	Representative rock chip sample, dump of old abandoned mine shaft; partly oxidized mineralized Deadwood hornfels, ± 5% pyrite, partly oxidized.	2100 (.061)	35
2664 (11/25/87)	SW¼, NW¼, Sec. 5 Head of Butcher Gulch 748,230 N 1,127,820 E	Representative rock chip sample from prospect dump; oxidized, silicified, altered Deadwood hornfels, abundant oxidized pyrite, near contact with trachyte porphyry.	1150 (.033)	2.3
2665 (12/1/87)	NE¼, SW¼, Sec. 5 Head of Ruby Gulch 747,500 N 1,128,330 E	Rock chip sample, dump of prospect trench, oxidized, mineralized trachyte porphyry, clots of limonites after mafics.	1100 (.032)	3.3
2666 (12/1/87)	NW¼, SE¼, Sec. 5 Head of Ruby Gulch 747,010 N 1,129,230 E	Rock chip sample of float, near outcrop, mineralized trachyte porphyry, strong alteration with disseminated limonite after pyrite 2-5%.	15	1.1
2667 (12/1/87)	Near SE Corner, SE¼, SW¼, Sec. 5 500' E. of Hoodoo Shaft 745,030 N 1,128,510 E	Rock chip sample wall, of prospect cut; mineralized breccia on contact of quartz trachyte porphyry; angular fragments of trachyte porphyry and Precambrian schist in a quartz trachyte porphyry matrix; very high sulfides with jarositic limonites, representative.	80 (.002)	1.1

GEOCHEMICAL SAMPLE DATA SHEET

PROJECT: GILT EDGE AREA, MAPPING AND RECON.

Rock Chip Samples collected by R.L. Nielsen, November - December 1987, April - June 1988

SAMPLE NUMBER	LOCATION	SAMPLE DESCRIPTION	Au ppb (oz./ton)	Ag ppm
2668 (12/5/87)	1/2 mi. SW of Dome Mt. NW¼, SW¼, Sec. 32 T5N, R4E	Representative rock chip sample down wall of prospect pit, 6' chip sample across mineralized beds of Deadwood quartzite; heavy sulfide mineralization (5%) oxidized to jarosite and goethite.	760 (.022)	1.5
2669 (4/28/88)	Near NE corner, SE¼, SE¼, Sec. 35 T5N, R3E Head of Spruce Gulch 752,340 N 1,116,920 E	Select rock chip sample of mineralized Deadwood hornfels from dump of old prospect; pods of gossan, limonites and partly oxidized pyrite in a siliceous matrix replacing limey silstone.	2260 (.066)	11
2670 (4/28/88)	SE¼, SE¼, Sec. 35 T5N, R3E Head of Spruce Gulch 752,180 N 1,116,600 E	Representative rock chip sample, natural outcrop and float; limonite-stained Deadwood quartzite with some calcareous siltstone, silicified and replaced by gossanous limonites.	15	0.7
2671 (4/28/88)	SE¼, SE¼, Sec. 35 Head of Spruce Gulch 751,370 N 1,117,020 E	Representative rock chip sample of outcrop or float near outcrop; mineralized trachyte porphyry and hornblende dacite, the latter is vuggy with 1% disseminated pyrite and strong propylitic to clay-sericite alteration.	233 (.007)	< 0.1
2672 (2/28/88)	SE¼, SE¼, Sec. 35 Head of Spruce Gulch 752,320 N 1,116,920 E	Representative rock chip sample from dump of small prospect pit; oxidized medium-grained vuggy hornblende dacite; +2% disseminated pyrite (oxidized), sheared with silicification.	13	0.2

GEOCHEMICAL SAMPLE DATA SHEET

PROJECT: GILT EDGE AREA, MAPPING AND RECON.

Rock Chip Samples collected by R.L. Nielsen, November - December 1987, April - June 1988

SAMPLE NUMBER	LOCATION	SAMPLE DESCRIPTION	Au ppb (oz./ton)	Ag ppm
2673 (4/28/88)	Near SE Corner, NW¼, SE¼, Sec. 35 T5N, R3E 752,620 N 1,116,600 E	Representative rock chip sample, dump of small prospect pit; ferrugenous quartzite and calcareous siltstone of the Deadwood formation; limonites and gossanous replacements of sulfides.	< 5	0.4
2674 (4/28/88)	SE¼, NE¼, Sec. 35 Upper Spruce Gulch 754,370 N 1,116,600 E	Representative rock chip sample, dump of prospect; Hornblende dacite porphyry sill, weak bleaching, propylitic alteration with ca. 1% disseminated pyrite (oxidized).	750 (.021)	0.8
2675 (4/28/88)	Near SE corner, NE¼, SE¼, Sec. 35 T5N, R3E 752,480 N 1,117,120 E	Representative rock chip sample, dump of small prospect; mineralized Deadwood quartzite with abundant gossanous limonite.	218 (.007)	0.7
2676 (4/28/88)	Near SW Corner, NW¼, SW¼, Sec. 36 T5N, R3E 752,700 N 1,117,200 E	Representative rock chip sample, dump of prospect pit in mineralized Deadwood quartzite; abundant limonites after sulfides.	6	0.6
2677 (4/28/88)	Near SW Corner, SW¼, NW¼, Sec. 36 T5N, R3E 753,670 N 1,117,225 E	Rock chip sample, dump of prospect pit; slightly high graded with selected gossanous material, mineralized Deadwood hornfels; gossanous limonite after massive pyrite replacing limey beds.	1693 (.049)	0.8

GEOCHEMICAL SAMPLE DATA SHEET

PROJECT: GILT EDGE AREA, MAPPING AND RECON.

Rock Chip Samples collected by R.L. Nielsen, November - December 1987, April - June 1988

SAMPLE NUMBER	LOCATION	SAMPLE DESCRIPTION	Au ppb (oz./ton)	Ag ppm
2678 (4/28/88)	Near NW Corner, SW¼, NW¼, Sec. 36 754,750 N 1,117, 360 E	Representative rock chip sample from dump of prospect pit; altered and mineralized hornblende dacite porphyry; propylitic alteration; ca 1% disseminated and fracture-controlled pyrite (oxidized).	213 (.006)	0.5
2679 (4/28/88)	NW¼, SW¼, Sec. 36 752,700 N 1,117,520 E	Representative rock chip sample, dump of small prospect pit; reddish-purple mineralized Deadwood quartzite and hornfels, strong limonite after sulfides and chalcedonic silica.	35 (.0011)	0.1
2680 (2/29/88)	NW¼, SW¼, Sec. 36 755,730 N 1,117,870 E	Selected high grade rock chip sample, dump of prospect pit; bleached mineralized hornblende dacite porphyry; slightly vuggy with propylitic alteration; strong oxidized sulfides along structure, sample of mineralized breccia.	4500 (.131)	0.2
2681 (4/29/88)	NW¼, SW¼, Sec. 35 T5N, R3E 753,130 N 1,118,270 E	Representative rock chip sample of mineralized breccia from dump of prospect trench; greenish gray brecciated Deadwood hornfels, silicified fragments in a limonite matrix after sulfides.	35	0.1
2682 (4/29/88)	Near SW Corner, NE¼, NW¼, Sec. 36 T5N, R3E 754,975 N 1,118,725 E	Slightly high graded rock chip sample, dump of prospect pit, weakly mineralized Deadwood hornfels, nodules of carbonate replaced by limonites after sulfides.	25	0.1
2683 (4/29/88)	SE¼, NW¼, Sec. 36 T5N, R3E 754,250 N 1,118,720 E	Representative rock chip sample, dump of prospect pit; medium grained vuggy hornblende dacite porphyry, weak propylitic alteration with 1% disseminated py.	68	0.6

GEOCHEMICAL SAMPLE DATA SHEET

PROJECT: GILT EDGE AREA, MAPPING AND RECON.

Rock Chip Samples collected by R.L. Nielsen, November - December 1987, April - June 1988

SAMPLE NUMBER	LOCATION	SAMPLE DESCRIPTION	Au ppb (oz./ton)	Ag ppm
2684 (4/29/88)	NW¼, NW¼, Sec. 36 T5N, R3E 754,860 N 1,118,150 E	Rock chip sample, dump of old prospect adit; Deadwood quartzite in contact with hornblende dacite porphyry. Sample of mineralized quartzite, silicified, jaspery alteration with abundant limonite after pyrite.	4340 (.126)	2.6
2685 (4/29/88)	NW¼, NW¼, Sec. 36 T5N, R3E 755,410 N 1,118,000 E	Select rock chip sample, dump of prospect pit; mineralized Deadwood quartzite, ferrugenous matrix, nodules of gossanous limonites; quartzite cut by limonite-lined fractures.	2800 (.081)	1.0
2686 (4/29/88)	NW¼, NW¼, Sec. 36 T5N, R3E 755,690 N 1,117,870 E	Select, slightly high grade rock chip sample from dump and walls of prospect pit; medium-grained vuggy hornblende dacite porphyry cut by steep limonite-coated fractures (N20°E).	6600 (.191)	1.6
2687 (4/29/87)	SW¼, SW¼, Sec. 25 T5N, R3E 756,470 N 1,117,990 E	Slightly high grade rock chip sample, dump of prospect pit, hornblende dacite altered to aplitic rock; about 2% disseminated pyrite oxidized to limonite.	108 (.003)	0.1
2688 (4/29/88)	NW¼, NW¼, Sec. 36 T5N, R3E 755,720 N 1,118,150 E	Select rock chip sample, dump of prospect adit; mineralized Deadwood hornfels, silicified with gossanous blebs of oxidized sulfides.	>10,000 (>.292)	6.2
2689 (4/30/88)	NE¼, NW¼, Sec. 36 T5N, R3E 755,450 N 1,119,370 E	Select rock chip sample, dump of small prospect pit; medium-grained hornblende dacite porphyry with vuggy cavities containing clots of limonite; limonites on fractures and in narrow breccia zones.	78	0.1

GEOCHEMICAL SAMPLE DATA SHEET

PROJECT: GILT EDGE AREA, MAPPING AND RECON.

Rock Chip Samples collected by R.L. Nielsen, November - December 1987, April - June 1988

SAMPLE NUMBER	LOCATION	SAMPLE DESCRIPTION	Au ppb (oz./ton)	Ag ppm
2690 (2/30/88)	NW¼, NE¼, Sec. 36 T5N, R3E 755,360 N 1,120,010 E	Select rock chip sample, dump of prospect pit, medium-grained hornblende dacite porphyry; vuggy with clots of limonite in vugs and limonite on fractures.	> 10,000 (> .292)	1.0
2691 (4/30/88)	NW¼, NE¼, Sec. 36 755,830 N 1,120,460 E	Select rock chip sample, dump of prospect pit; medium grained hornblende dacite porphyry, propylitic alteration; blocky fractures with limonite after sulfides on fractures.	81	0.1
2692 (4/30/88)	NE¼, NW¼, Sec. 36 755,840 N 1,118,940 E	Rock chip sample dump of prospect pit, medium-grained hornblende dacite porphyry sill, slightly vuggy Mn oxide and limonites on fractures.	69	0.1
2693 (2/30/88)	SE¼, SW¼, Sec. 25 T5N, R3E 756,230 N 1,118,890 E	Select rock chip sample, dump of small prospect; ocherous brown ferrugenous Deadwood hornfels, some limonite may be after sulfide but much appears matrix to sandstone.	117 (.003)	0.1
2694 (4/30/88)	SE¼, SW¼, Sec. 25 T5N, R3E 758,100 N 1,119,385 E	Representative rock chip sample, dump of shaft, soft, clayey ocherous gossan, possible oxidized massive sulfide replacement of Deadwood hornfels.	1226 (.036)	0.9
2695 (4/30/88)	NE¼, SW¼, Sec. 25 758,260 N 1,119,105 E	Representative rock chip sample, dump of prospect. Ordivician quartzite and shale; heavily impregnated by sulfide now oxidized to limonites.	796 (.023)	1.0
2696 (4/30/88)	SE¼, SW¼, Sec. 25 757,410 N 1,119,230 E	Representative rock chip sample, dump of shaft, mineralized Deadwood hornfels, ferrugenous sandstone and calcareous siltstone heavily replaced by sulfides now oxidized to limonites.	1598 (.046)	0.2

GEOCHEMICAL SAMPLE DATA SHEET

PROJECT: GILT EDGE AREA, MAPPING AND RECON.

Rock Chip Samples collected by R.L. Nielsen, November - December 1987, April - June 1988

SAMPLE NUMBER	LOCATION	SAMPLE DESCRIPTION	Au ppb (oz./ton)	Ag ppm
2697 (5/5/88)	NE¼, NW¼, Sec. 36 T5N, R3E 754,930 N 1,119,420 E	Representative rock chip sample, walls and dump of small prospect; medium-grained gray hornblende dacite. Vuggy with 1% oxidized pyrite disseminated in vugs, propylitic alteration.	8	0.1
2698 (5/5/88)	Near NE Corner, NW¼, SW¼, Sec. 36 T5N, R3E 753,260 N 1,118,550 E	Representative rock chip sample, dump of prospect pit medium-grained, gray hornblende dacite porphyry, propylitic alteration and 1% disseminated oxidized pyrite in vugs.	119	0.6
2699 (5/5/88)	Near NE Corner, NE¼, SW¼, Sec. 36 T5N, R3E 753,340 N 1,118,640 E	Representative rock chip sample, dump of prospect pit, mineralized breccia with angular fragments of hornblende dacite, Precambrian schist, Deadwood hornfels in a dark siliceous matrix with abundant clots and veinlets of limonite after sulfides,	538 (.016)	2.4
2700 (5/5/88)	NE¼, SW¼, Sec. 36 T5N, R3E 753,265 N 1,119,280 E	Select rock chip sample, dump of prospect pit; vuggy, brecciated mineralized Deadwood quartzite, and hornblende dacite porphyry, with clots of limonites after sulfide disseminated through the rock.	< 5	0.2
2951 (5/5/88)	NE¼, SE¼, Sec. 36 T5N, R3E 752,700 N 1,118,900 E	Rock chip sample, natural outcrop of breccia, angular fragments of hornblende dacite porphyry and Deadwood hornfels in a greenish propylitically altered matrix with disseminated limonites after pyrite.	165 (.005)	0.8
2952 (5/6/88)	Near SW Corner NE¼, SW¼, Sec. 36 752,200 N 1,118,730 E	Rock chip sample, dump of prospect; mineralized breccia with angular fragments of Precambrian schist, mineralized Deadwood hornfels in a white siliceous "tuffaceous" matrix with bi-pyramidal quartz phenocrysts	40	0.2

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PROJECT: GILT EDGE AREA, MAPPING AND RECON.

Rock Chip Samples collected by R.L. Nielsen, November - December 1987, April - June 1988

SAMPLE NUMBER	LOCATION	SAMPLE DESCRIPTION	Au ppb (oz./ton)	Ag ppm
2953 (5/6/88)	SE¼, SW¼, Sec. 35 752,170 N 1,119,580 E	High grade rock chip sample from dump of prospect pit; Deadwood hornfels, reddish-brown jaspery silicification with gossanous limonites.	2310 (.067)	0.9
2954 (5/6/88)	SW¼, SE¼, Sec. 36 T5N, R3E 751,880 N 1,119,890 E	Representative rock chip sample, dump of caved adit; white, limonite-stained medium-grained hornblende dacite porphyry, vuggy with 1% disseminated limonite after pyrite.	150	0.2
2955 (5/9/88)	Near NE Corner SW¼, NW¼, Sec. 31 T5N, R3E 754,460 N 1,123,640 E	Representative rock chip sample, dump of prospect adit; ocherous, rusty ferrugenous sandstone of the Deadwood fm, some gossanous layers.	10	0.4
2956 (5/10/88)	NW¼, NE¼, Sec. 1 T4N, R3E 750,700 N 1,118,850 E	Representative rock chip sample, exposure in prospect pit; Deadwood quartzite with limonite matrix and clots of gossanous limonites after sulfides.	51	0.4
2957 (5/10/88)	NW¼, NE¼, Sec. 36 T5N, R3E 755,740 N 1,120,990 E	Representative rock chip sample, dump of prospect shaft; hornblende trachyte porphyry with disseminated pyrite on fractures and propylitic alteration; oxidized.	< 5	0.3
2958 (5/10/88)	NW¼, NE¼, Sec. 36 T5N, R3E 755,740 N 1,120,990 E	Representative rock chip sample, dump of prospect shaft collared in Qal; sample of Deadwood quartzite and hornfels; weakly mineralized with limonite in matrix and on fractures in ferrugenous sandstone.	171	0.4

GEOCHEMICAL SAMPLE DATA SHEET

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Rock Chip Samples collected by R.L. Nielsen, November - December 1987, April - June 1988

SAMPLE NUMBER	LOCATION	SAMPLE DESCRIPTION	Au ppb (oz./ton)	Ag ppm
2959 (5/10/88)	NE¼, NE¼, Sec. 36 T4N, R3E 755,240 N 1,121,540 E	Representative rock chip sample; dump of prospect pit; ferrugenous sandstone of Deadwood hornfels; many calcite veinlets; oxidized.	5	0.6
2960 (5/10/88)	SE¼, NE¼, Sec. 36 T5N, R3E 754,555 N 1,121,400 E	Rock chip sample, dump of flooded shaft; unoxidized Deadwood quartzite; gray, fractured with about 5% disseminated pyrite and vuggy quartz.	796 (.023)	20.0
2961 (5/12/88)	SE¼, NE¼, Sec. 36 T5N, R3E 754,300 N 1,121,650 E	Rock chip sample, dump of prospect pit; representative sample of ocherous limonitic dolomitic sandstone of Deadwood hornfels, oxidized.	29	0.8
2962 (5/12/88)	SW¼, SE¼, Sec. 36 T5N, R3E 751,070 N 1,120,970 E	Representative rock chip sample from exposure in prospect pit, siliceous siltstone of Deadwood hornfels; fractured and brecciated, cemented by goethite after sulfide; possible fault zone; oxidized.	43	0.6
2963 (5/12/88)	NE¼, NW¼, Sec. 6 T4N, R4E 749,705 N 1,122,625 E	Representative rock chip sample, dump of prospect; hornblende trachyte porphyry sill, propylitic alteration, weak goethite limonite after sulfides and weak silicification.	< 5	0.3
2964 (5/13/88)	NE¼, SW¼, Sec. 31 T4N, R4E 753,170 N 1,123,890 E	Rock chip sample, prospect cut, 5 to 10-foot wide chloritized fault breccia between hornblende trachyte porphyry and Deadwood hornfels; weak silicification and minor limonite clots and veinlets.	36	2.0

GEOCHEMICAL SAMPLE DATA SHEET

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Rock Chip Samples collected by R.L. Nielsen, November - December 1987, April - June 1988

SAMPLE NUMBER	LOCATION	SAMPLE DESCRIPTION	Au ppb (oz./ton)	Ag ppm
2965 (6/2/88)	Near SW Corner NW¼, NE¼, Sec. 6 T4N, R4E 749,620 N 1,123,795 E	Representative rock chip sample, dump of prospect shaft; sheared and brecciated Deadwood hornfels with jaspery silica alteration and abundant gossanous limonite after sulfide.	139	1.4
2966 (6/2/88)	SW¼, NE¼, Sec. 6 T4N, R4E 748,850 N 1,124,395 E	Representative rock chip sample, dump of prospect pit; hornblende trachyte porphyry, bleached, propylitic alteration faced with limonite veinlets and limonites after disseminated pyrite; oxidized.	21	.2
2967 (6/2/88)	NW¼, NE¼, Sec. 6 T4N, R4E 750,115 N 1,124,410 E	Rock chip sample, dump of prospect pit, selected sample of gossanous dolomite of Deadwood hornfels, probably mineralized fault zone.	231	.6
2968 (6/2/88)	Near SW Corner NW¼, NE¼, Sec. 6 749,700 N 1,123,755 E	Representative sample, dump of prospect adit, sample of fractured, brecciated and mineralized dolomitic siltstone of Deadwood hornfels; gossanous blebs in breccia; oxidized.	52	.4
2969 (6/3/88)	SW¼, NE¼, Sec. 1 T4N, R3E 748,860 N 1,119,030 E	Rock chip sample across 6 foot face in prospect cut; fine-grained Deadwood quartzite and hornfels; limonite matrix and on fractures; some after sulfides; oxidized.	211	.1
2970 6/3/88)	Near SW Corner NW¼, NE¼, Sec. 1 T4N, R3E 749,500 N 1,118,430 E	Representative rock chip sample, natural outcrop; Deadwood dolomite and silty dolomite; very weak limonite mineralization; near contact with quartz trachyte porphyry.	12	< .1

GEOCHEMICAL SAMPLE DATA SHEET

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SAMPLE NUMBER	LOCATION	SAMPLE DESCRIPTION	Au ppb (oz./ton)	Ag ppm
2971 (6/3/88)	SE¼, NW¼, Sec. 1 749,430 N 1,117,720 E	Rock chip sample, dump of caved adit; select sample of mineralized hydrothermal breccia, fragments of Deadwood hornfels in limonite matrix.	166	3.1
2972 (6/3/88)	SW¼, NE¼, Sec. 1 T4N, R3E 749,050 N 1,119,190 E	Rock chip sample from "ore" stock pile near 2-Bit adit; mineralized quartzite and hornfels of Deadwood formation; brecciated with quartz veinlets, limonite after sulfides, and specularite.	6200 (.180)	> 50.0
2973 (6/4/88)	NE¼, NE¼, Sec. 1 T4N, R3E 749,795 N 1,120,320 E	Rock chip sample, float, select sample of altered and mineralized Deadwood quartzite; bleached and laced with limonite veinlets.	24	1.0
2974 (6/4/88)	SE¼, NE¼, Sec. 1 749,530 N 1,120,640 E	Representative rock chip sample, dump of prospect adit driven on low angle contact between hornblende trachyte porphyry and gray Deadwood argillite; select sample of fractured hornfels with limonite.	46	1.5
2975 (6/4/88)	SE¼, NE¼, Sec. 1 748,650 N 1,119,780 E	Representative rock chip sample, 4 feet down exposure and across beds exposed in portal of caved adit; fractured and brecciated gray argillite of Deadwood hornfels, laced with veinlets of calcite, iron carbonate and limonites.	33	.1
2976 (6/5/88)	SW¼, NE¼, Sec. 1 T4N, R3E 748,500 N 1,119,440 E	Rock chip sample, dump of adit at Mary mine; selected to represent mineralized Deadwood quartzite; fractured, laced with coxcomb quartz veinlets, limonite veinlets, with disseminated pyrite, oxidized.	> 10000 (1.022)	> 50.0

GEOCHEMICAL SAMPLE DATA SHEET

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SAMPLE NUMBER	LOCATION	SAMPLE DESCRIPTION	Au ppb (oz./ton)	Ag ppm
2977 (6/5/88)	SW¼, NE¼, Sec. 1 T4N, R3E 748,410 N 1,119,450 E	Rock chip sample dump of adit at Mary mine; selected to represent mineralized siltstone and dolomitic siltstone of Deadwood hornfels; strongly fractured with abundant limonite after sulfides.	440 (.013)	38.0
2978 (6/5/88)	SW¼, NE¼, Sec. 1 T4N, R3E 748,380 N 1,119,260 E	Representative rock chip sample from wall of prospect pit at Mary mine; strongly fractured and limonite-impregnated argillite and dolomitic siltstone of Deadwood hornfels.	124	1.3
2979 (6/5/88)	SE¼, NE¼, Sec. 1 T4N, R3E 748,315 N 1,119,160 E	Representative rock chip sample wall of prospect pit at Mary mine; strongly fractured and mineralized Deadwood hornfels and quartzite; abundant limonite after pyrite with hydrothermal silica alteration; oxidized.	33	.6
2980 (6/5/88)	NE¼, SE¼, Sec. 1 747,230 N 1,119,735 E	Rock chip sample, dump of caved adit; selected mineralized material, brown jaspery silica and gossan; probably mineralized fault cut by adit.	735	44.4
2981 (6/5/88)	Near Center SE¼, Sec. 1 746,810 N 1,119,435 E	Rock chip sample, dump of small prospect, selected to represent mineralized Deadwood quartzite, strong limonite after sulfides in breccia matrix; possible mineralized fault.	18	.8
2982 (6/5/88)	SW¼, SE¼, Sec. 1 T4N, R3E 746,815 N 1,119,140 E	Representative rock chip sample, dump of prospect pit; brecciated, silicified and mineralized Deadwood hornfels; bleached with chalcedonic silica and limonite.	80	2.1

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2983 (6/5/88)	SW¼, SE¼, Sec. 1 T4N, R3E 746,475 N 1,119,430 E	Representative rock chip sample dump of prospect in mineralized breccia; angular fragments of altered Precambrian schist, Deadwood hornfels, and hornblende trachyte porphyry in a white quartz trachyte matrix with limonite veinlets and disseminations.	9	.5
2984 (6/5/88)	SE¼, SW¼, Sec. 1 746,100 N 1,117,750 E	Representative rock chip sample, exposure in prospect pit; limonite impregnated Deadwood quartzite; ferrugenous dolomitic quartzite.	9	.3
2985 (6/6/88)	SE¼, NE¼, Sec. 1 748,400 N 1,119,600 E	Rock chip sample, dump of prospect pit, blocky Deadwood quartzite with disseminated limonites after sulfides in quartzite matrix and on fractures.	54	.5
2986 (6/6/88)	SW¼, NE¼, Sec. 1 747,980 N 1,119,540 E	Rock chip sample, 4 feet down exposure in prospect cut; fractured Deadwood quartzite laced with white quartz veinlets and limonite veinlets.	97	.11
2987 (6/6/88)	NE¼, SE¼, Sec. 1 T4N, R3E 748,090 N 1,119,850 E	Rock chip sample dump of prospect pit, selected gossan-massive sulfide replacement of mineralized Deadwood dolomitic siltstone; probable mineralized fault zone.	3550 (.103)	2.2
2988 (6/6/88)	NE¼, SE¼, Sec. 1 T4N, R3E 747,500 N 1,119,830 E	Rock chip sample, dump of prospect adit, selected gossan fragments; jaspery with quartz veinlets; probably a mineralized fault.	326 (.009)	43.4

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SAMPLE NUMBER	LOCATION	SAMPLE DESCRIPTION	Au ppb (oz./ton)	Ag ppm
2989 (6/7/88)	NE¼, SE¼, Sec. 1 747,390 N 1,120,955 E	Rock chip sample, dump of prospect pit along fault; brown jaspery vein silica and jaspery replacement of dolomite of Deadwood hornfels.	145	1.7
2990 (6/7/88)	NE¼, SE¼, Sec. 1 747,200 N 1,120,950 E	Rock chip sample, dump of prospect pit along fault; mineralized and sheared Deadwood hornfels; select sample of porous vuggy gossan.	6620 (.192)	10.1
2991 (6/7/88)	SE¼, SE¼, Sec. 1 T4N, R3E 746,430 N 1,120,600 E	Rock chip sample, dump of prospect pit along fault; select high graded sample of mineralized Deadwood hornfels and hornblende trachyte porphyry; bleached, laced with quartz and limonite veinlets.	408 (.012)	> 50.0
2992 (6/7/88)	SW¼, SW¼, Sec. 6 T4N, R4E 746,000 N 1,121,150 E	Rock chip sample, dump of prospect pit; selected mineralized samples of Deadwood hornfels and hornblende trachyte porphyry; bleached and laced with limonite veinlets; some gossanous blebs.	50	1.8
2993 (6/7/88)	NW¼, SW¼, Sec. 6 T4N, R4E 747,870 N 1,121,580 E	Representative rock chip sample from exposure in portal of prospect adit; Deadwood hornfels cut by structure that trends N60°E - 80°S; weak limonites after sulfides; carbonate veins.	633 (.018)	17.5
2994 (6/8/88)	SW¼, SW¼, Sec. 6 T4N, R4E 745,270 N 1,121,435 E	Rock chip sample, dump of prospect adit; select sample of mineralized Deadwood quartzite; quartz-limonite veins and impregnations; oxidized.	23	1.0

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SAMPLE NUMBER	LOCATION	SAMPLE DESCRIPTION	Au ppb (oz./5on)	Ag ppm
2995 (6/8/88)	SE¼, SW¼, Sec. 6 T4N, R4E 745,090 N 1,122,700 E	Representative rock chip sample down wall of prospect pit; reddish brown mineralized Deadwood hornfels; sheared and impregnated with limonites; fault trends N40°W, 90° dip.	> 10000 (.323)	2.2
2996 (6/8/88)	SW¼, SW¼, Sec. 6 746,395 N 1,121,670 E	Representative rock chip sample, from prospect pit near Golden Crest vein; crushed and fractured hornblende trachyte porphyry with propylitic alteration and moderate limonites after sulfides.	64	.3
2997 (6/8/88)	NW¼, SE¼, Sec. 6 T4N, R4E 747,740 N 1,123,290 E	Representative rock chip sample, dump of prospect pit; fractured and crushed hornblende trachyte porphyry, limonite after disseminated pyrite, quartz-sericite alteration and jarosite.	3020 (.088)	> 50.0
2998 (6/8/88)	NW¼, SW¼, Sec. 6 T4N, R4E 747,850 N 1,122,690 E	Representative rock chip sample of vein exposure in prospect pit, porous cellular gossan, 20-30" wide, with jasper, jarosite, vuggy quartz, alunite and clay.	2200 (.064)	19.2
2999 (6/8/88)	SE¼, NW¼, Sec. 6 T4N, R4E 747,970 N 1,122,550 E	Representative rock chip sample, dump of prospect pit; soft ocherous limonites and clay from mineralized structure in silicified hornblende trachyte porphyry, oxidized.	864 (.025)	> 50.0
3000 (6/9/88)	SW¼, SE¼, Sec. 6 T4N, R4E 747,750 N 1,123,820 E	Representative rock chip sample, 5 feet down wall of prospect pit; hornblende trachyte porphyry is bleached with propylitic alteration and blocky fractures with goethite Mn oxides.	51	0.6

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SAMPLE NUMBER	LOCATION	SAMPLE DESCRIPTION	Au ppb (oz./ton)	Ag ppm
4001 (6/9/88)	NW¼, SE¼, Sec. 6 T4N, R4E 746,670 N 1,123,970 E	Rock chip sample, dump of prospect pit; select sample of mineralized fault zone in hornblende trachyte porphyry and Deadwood hornfels; jaspery gossan with quartz-limonite veinlets; quartz-sericite-clay-alunite alteration.	5710 (.166)	36.5
4002 (6/9/88)	NW¼, SE¼, Sec. 6 T4N, R4E 746,975 N 1,123,905 E	Rock chip sample, dump of prospect pit on mineralized fault; brown brecciated hornblende trachyte porphyry; breccia matrix and veinlets of vuggy quartz and limonites after sulfides; oxidized.	1412 (.041)	4.7
4003 (6/9/88)	NW¼, SE¼, Sec. 6 T4N, R4E 747,460 N 1,124,250 E	Rock chip sample, dump of prospect shaft, hornblende trachyte porphyry with very abundant subhorizontal fractures, quartz veinlets, and disseminated goethite-jarosite after sulfides (5%), now oxidized.	2610 (.076)	4.9
4004 (6/10/88)	NE¼, NW¼, Sec. 6 T4N, R4E 749,980 N 1,123,405 E	Representative rock chip sample outcrop and wall of prospect cut, hornblende trachyte porphyry, fractured by N40°W fault, weakly disseminated limonite after pyrite on fractures.	43	0.1
4005 (6/10/88)	SE¼, NW¼, Sec. 6 T4N, R4E 748,145 N 1,123,660 E	Select rock chip sample, dump of prospect pit on fracture zone, hornblende trachyte porphyry, bleached white, quartz-sericite alteration, weak limonites after sulfides; oxidized.	375 (.011)	1.9
4006 (6/10/88)	SE¼, NW¼, Sec. 6 748,430 N 1,122,830 E	Rock chip sample, dump of prospect adit, strongly fractured hornblende trachyte porphyry; quartz-sericite alteration, pervasive silica, and ca. 5% disseminated py, now oxidized to goethite and jarosite.	1613 (.047)	21.3

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SAMPLE NUMBER	LOCATION	SAMPLE DESCRIPTION	Au ppb (oz./ton)	Ag ppm
4007 (6/10/88)	SE¼, NW¼, Sec. 6 748,400 N 1,127,770 E	Rock chip sample of mineralized material from dump of prospect adit; hornblende trachyte porphyry with quartz-limonite veinlets and quartz-sericite alteration on margin of unaltered stock.	2050 (.059)	18.3
4008 (6/10/88)	NW¼, SE¼, Sec. 6 T4N, R4E 748,055 N 1,124,125 E	Representative rock chip sample, dump of prospect pit; fractured and shattered hornblende trachyte porphyry, bleached white with clay-sericite alteration with goethite-jarosite after disseminated and veinlet sulfides.	87	1.1
4009 (6/10/88)	SW¼, NE¼, Sec. 6 T4N, R4E 748,185 N 1,124,615 E	Rock chip sample dump of prospect pit, select sample of mineralized Deadwood quartzite, hornfels and minor hornblende trachyte porphyry; silicified with disseminated pyrite and quartz-sulfide veinlets (oxidized).	163	0.7
4010 (6/10/88)	SW¼, NE¼, Sec. 6 T4N, R4E 748,380 N 1,124,800 E	Representative rock chip sample, dump of prospect shaft; hornblende trachyte porphyry; subhorizontal sheeting; silicified with propylitic alteration and disseminated and veinlet pyrite; partly oxidized.	125	0.3
4011 (6/10/88)	SE¼, NE¼, Sec. 6 747,880 N 1,125,030 E	Rock chip sample, dump of prospect pit; hornblende trachyte porphyry; crushed with clay-sericite alteration and disseminated and quartz-limonite veinlets after pyrite.	185	1.4
4012 (6/11/88)	SE¼, NE¼, Sec. 6 748,060 N 1,125,725 E	Representative sample from dump of prospect pit; hornblende trachyte porphyry; strong propylitic alteration and stockworks quartz veinlets; about 3 to 5% disseminated pyrite, oxidized to goethite and jarosite.	254	4.5

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SAMPLE NUMBER	LOCATION	SAMPLE DESCRIPTION	Au ppb (oz./ton)	Ag ppm
4013 (6/11/88)	SE¼, NE¼, Sec. 6 748,075 N 1,125,665 E	Same as above, but different prospect pit	486 (.014)	0.9
4014 (6/11/88)	NE¼, SE¼, Sec. 6 T4N, R4E 747,775 N 1,124,800 E	High graded rock chip sample from dump of prospect pit; hornblende trachyte porphyry, strongly sheared and fractured; strong clay-sericite alteration and limonites after sulfides.	611 (.018)	5.1
4015 (6/11/88)	NW¼, SE¼, Sec. 6 T4N, R4E 746,715 N 1,124,600 E	Representative rock chip sample dump of prospect pit in mineralized breccia; fragments of hornblende trachyte porphyry in a limonite-quartz matrix; quartz-sericite alteration.	3030 (.088)	> 50.0
4016 (6/11/88)	SW¼, SE¼, Sec. 6 T4N, R4E 746,135 N 1,124,445 E	Select rock chip sample of mineralized fault breccia, dump of prospect pit; hornblende trachyte porphyry is sheard and brecciated, bleached, quartz-sericite alteration; jaspery silica alteration, with limonite in breccia matrix.	1042 (.030)	21.5
4017 (6/12/88)	SW¼, SE¼, Sec. 6 T4N, R4E 745,595 N 1,124,410 E	Select sample gossanous rock from dump of prospect pit; sheared Deadwood hornfels; siltstone and dolomitic siltstone, jaspery silica alteration with gossanous blebs.	1775 (.051)	17.9
4018 (6/12/88)	SE¼, SE¼, Sec. 6 T4N, R4E 745,555 N 1,124,995 E	Select sample, mineralized rock from dump of prospect trench; hornblende trachyte porphyry shear zone with clay-sericite alteration and many limonite veinlets, some jaspery silica; possible fault.	1059 (.031)	3.6

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PROJECT: GILT EDGE AREA, MAPPING AND RECON.

Rock Chip Samples collected by R.L. Nielsen, November - December 1987, April - June 1988

SAMPLE NUMBER	LOCATION	SAMPLE DESCRIPTION	Au ppb (oz./ton)	Ag ppm
4019 (6/13/88)	SE¼, SE¼, Sec. 1 T4N, R3E 745,700 N 1,119,600 E	High grade mineralized rock chip sample, dump of adit; adit in weakly altered hornblende trachyte porphyry; sample is limonite-rich jasper with gossan blebs and bands; probable fault zone.	693 (.020)	> 50.0
4020 (6/13/88)	NW¼, NE¼, Sec. 12 T4N, R3E 744,700 N 1,119,435 E	High grade rock chip sample, dump of prospect shaft; hornblende trachyte porphyry, strongly fractured with subhorizontal sheeting; limonite veinlets and weak pervasive silicification, oxidized.	19	20.8
4021 (6/13/88)	SE¼, SE¼, Sec. 1 T4N, R3E 745,800 N 1,119,900 E	High grade rock chip sample, dump of prospect shaft, prominent fissure vein 1' wide cuts hornblende trachyte porphyry; vein is jaspery silica and gossan.	441	> 50.0
4022 (6/13/88)	NW¼, NW¼, Sec. 7 T4N, R4E 744,235 N 1,121,690 E	Representative rock chip sample from blocks at portal of prospect adit; Deadwood quartzite heavily impregnated with limonites, bands of dark red brown jaspery silica interlayered with spongy gossan bands.	8	18.2
4023 (6/14/88)	SE¼, NE¼, Sec. 4 T4N, R4E 747,700 N 1,135,780 E	Representative rock chip sample, dump of prospect trench; brown altered Deadwood quartzite; brecciated with jaspery silica alteration and gossanous bands of ocherous limonite.	2032 (.059)	27.7
4024 (6/14/88)	SE¼, NE¼, Sec. 4 T4N, R4E 747,635 N 1,136,050 E	Representative rock chip sample, dump of prospect pit; brown altered quartzite and dolomitic sandstone of the Cambrian Deadwood formation; jaspery alteration with blebs and bands of gossanous limonites.	25	1.5

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Rock Chip Samples collected by R.L. Nielsen, November - December 1987, April - June 1988

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4025 (6/14/88)	SE¼, NE¼, Sec. 4 T4N, R4E 747,700 N 1,135,940 E	Representative rock chip sample of blocks lying on dump of prospect pit; brown ferruginous dolomitic sandstone and quartzite of the Deadwood formation; red brown jaspery silica alteration with blebs of ocherous gossan.	6460 (.187)	> 50.0
4026 (6/14/88)	SE¼, NE¼, Sec. 4 T4N, R4E 747,895 N 1,135,670 E	Representative rock chip sample, dump of caved shaft; yellow-brown altered Deadwood hornfels and quartzite; weak jaspery silica alteration, with gossanous blebs and layers.	356 (.010)	11.2
4027 (6/14/88)	SW¼, NE¼, Sec. 4 T4N, R4E 748,035 N 1,135,210 E	Representative rock chip sample, dump of prospect cut; yellow-brown ferruginous dolomitic sandstone and quartzite of the Deadwood formation; patches of jaspery silica alteration, with gossanous layers; some breccia with jaspery matrix.	2750 (.08)	32.3
4028 (6/14/88)	SE¼, SE¼, Sec. 6 T4N, R4E 745,300 N 1,124,835 E	Select rock chip sample of mineralized fault zone, dump of prospect adit; hornblende trachyte porphyry fractured, brecciated and bleached with abundant limonite veinlets.	839 (.024)	7.2
4029 (6/15/88)	NW¼, NE¼, Sec. 7 T4N, R4E 744,770 N 1,123,515 E	High grade rock chip sample of mineralized rock from dump of prospect pit; sheared and bleached dolomitic siltstone from Deadwood hornfels; weak silicification and a little limonite after sulfide; oxidized.	50	28.0
4030 (6/15/88)	NW¼, NE¼, Sec. 7 T4N, R4E 744,655 N 1,123,585 E	High grade rock chip sample from dump of prospect trench; sheared and fractured Deadwood hornfels and hornblende trachyte porphyry, weak silicification, bleached, clay-sericite alteration, strong limonite after sulfides; oxidized.	1081 (.031)	25.0

GEOCHEMICAL SAMPLE DATA SHEET

PROJECT: GILT EDGE AREA, MAPPING AND RECON.

Rock Chip Samples collected by R.L. Nielsen, November - December 1987, April - June 1988

SAMPLE NUMBER	LOCATION	SAMPLE DESCRIPTION	Au ppb (oz./ton)	Ag ppm
4031 (6/15/88)	NE¼, NE¼, Sec. 7 T4N, R4E 744,700 N 1,125,555 E	Representative rock chip sample, dump of prospect pit; hornblende trachyte porphyry, crushed and fractured along fault zone, bleached white, quartz-sericite-clay alteration; limonite along fractures; oxidized.	76	1.2
4032 (6/15/88)	NE¼, NE¼, Sec. 7 T4N, R4E 744,550 N 1,125,720 E	Representative rock chip sample, dump of prospect pit; buff colored breccia, fragments of bleached silicified hornblende trachyte porphyry in a limonite matrix; pervasive silica alteration; oxidized.	371 (.011)	3.2
4033 (6/15/88)	NE¼, NE¼, Sec. 7 T4N, R4E 744,280 N 1,127,670 E	Representative rock chip sample, dump of prospect pit; mineralized breccia, bleached altered fragments of quartz trachyte porphyry and hornblende trachyte porphyry in a gossanous limonite matrix; abundant limonite oxidized.	724 (.021)	7.6
4034 (6/15/88)	NW¼, NE¼, Sec. 7 T4N, R4E 743,860 N 1,123,870 E	Select rock chip sample, dump of prospect pit; mineralized breccia, Deadwood hornfels, dark red limonites and clays; brecciated and sheared; oxidized; may be Golden Crest structure.	9	1.2
4035 (6/15/88)	NE¼, NW¼, Sec. 7 T4N, R4E 744,145 N 1,123,100 E	Select rock chip sample, dump of prospect pit. Shattered and sheared hornblende trachyte porphyry; bleached; clay-sericite alteration, limonite after sulfides on fractures and matrix to tectonic breccia; oxidized.	< 5	1.3
4036 (6/15/88)	NE¼, NW¼, Sec. 8 T4N, R4E 744,350 N 1,127,640 E	Representative rock chip sample, dump of prospect. Brecciated siltstone and quartzite of Deadwood formation; pervasive jaspery silica alteration; abundant limonites after sulfides.	319	3

GEOCHEMICAL SAMPLE DATA SHEET

PROJECT: GILT EDGE AREA, MAPPING AND RECON.

Rock Chip Samples collected by R.L. Nielsen, November - December 1987, April - June 1988

SAMPLE NUMBER	LOCATION	SAMPLE DESCRIPTION	Au ppb (oz./ton)	Ag ppm
4037 (6/24/88)	NE¼, NW¼, Sec. 8 T4N, R4E 744,610 N 1,127,735 E	Representative rock chip sample, dump of prospect adit. Bleached recrystallized quartzite of Deadwood formation; strong quartz-sericite altered hornblende trachyte porphyry; disseminated sulfide mzl.	100	3.9
4038 (6/25/88)	NW¼, NW¼, Sec. 8 T4N, R4E 744,325 N 1,127,100 E	Representative rock chip sample dump of prospect adit; mineralized breccia near contact with Tqtp; fragments of trachyte porphyry in a siliceous matrix of ground up trachyte and disseminated sulfides; completely oxidized; gossanous.	856 (.025)	4.5
4039 (6/25/88)	NW¼, NW¼, Sec. 8 T4N, R4E 744,290 N 1,127,340 E	Representative rock chip sample, dump of prospect pit. Mineralized and recrystallized Deadwood quartzite; fractured with vuggy and disseminated sulfides; partly oxidized, silicified.	76	2.8
4040 (6/25/88)	NE¼, NW¼, Sec. 8 T4N, R4E 744,465 N 1,127,450 E	Representative rock chip sample, dump of prospect adit; hornblende trachyte porphyry, fractured with disseminated pyrite, oxidized.	176	10.4
4041 (6/25/88)	NW¼, NW¼, Sec. 8 T4N, R4E 744,000 N 1,127,215 E	Representative rock chip sample, large blocks in prospect pit; mainly Deadwood quartzite, fractured, brecciated and laced with limonite; also hornblende trachyte porphyry; all altered and mineralized with disseminated sulfides.	880 (.025)	11.6
4042 (6/25/88)	NW¼, NW¼, Sec. 8 T4N, R4E 743,895 N 1,127,040 E	Representative rock chip sample, exposure in prospect cut; mineralized Deadwood quartzite; brecciated recrystallized, jaspery silica; abundant gossanous limonite.	3450 (.100)	15.9

GEOCHEMICAL SAMPLE DATA SHEET

PROJECT: GILT EDGE AREA, MAPPING AND RECON.

Rock Chip Samples collected by R.L. Nielsen, November - December 1987, April - June 1988

SAMPLE NUMBER	LOCATION	SAMPLE DESCRIPTION	Au ppb (oz./ton)	Ag ppm
4043 (6/25/88)	SE¼, SW¼, Sec. 5 T4N, R4E 744,900 N 1,128,370 E	Representative rock chip sample, dump of prospect adit; fine to medium grained granular hornblende trachyte porphyry; sericitic alteration and disseminated pyrite.	58	1.4
4044 (6/26/88)	SE¼, SW¼, Sec. 5 T4N, R4E 745,095 N 1,128,095 E	Representative rock chip sample, blocks in dump of prospect cut; pale gray mineralized trachyte porphyry; jarositic limonites after disseminated pyrite.	223	0.7
4045 (6/26/88)	SE¼, SW¼, Sec. 5 T4N, R4E 744,970 N 1,128,305 E	Representative chip sample mineralized outcrop of breccia; fragments of Precambrian schists. Deadwood quartzite and trachyte porphyry in a matrix of quartz, jarosite and tuff, strong sericitic alteration.	46	2.1
4046 (6/26/88)	SE¼, SW¼, Sec. 5 T4N, R4E 744,990 N 1,128,340 E	Representative chip sample of outcrop in cut, mineralized breccia; fragments of Deadwood quartzite, Precambrian schist, trachyte porphyry, in a matrix of quartzite, jarosite and adularia.	83	1.6
4047 (6/26/88)	SE¼, SW¼, Sec. 5 T4N, R4E 745,825 N 1,128,320 E	Select rock chip sample of gossanous material in prospect trench; reddish and yellow-brown jasperoid and gossan along fault zone cutting mineralized Cambrian Deadwood hornfels; strong mineralization.	960 (.028)	1.4
4048 (6/26/88)	NW¼, NE¼, Sec. 8 T4N, R4E 744,590 N 1,128,620 E	Select sample of "ore" from stockpile on dump; chips of gossanous Deadwood hornfels; ocherous brown limonite; nodular replacement of dolomite	1206 (.035)	28.3

GEOCHEMICAL SAMPLE DATA SHEET

PROJECT: GILT EDGE AREA, MAPPING AND RECON.

Rock Chip Samples collected by R.L. Nielsen, November - December 1987, April - June 1988

SAMPLE NUMBER	LOCATION	SAMPLE DESCRIPTION	Au ppb (oz./ton)	Ag ppm
4049 (6/26/88)	NW¼, NE¼, Sec. 8 T4N, R4E 744,375 N 1,128,565 E	Representative rock chip sample, dump of prospect adit; Gossanous Deadwood hornfels and quartzite brecciated and sheard, probably near fault; replacement of dolomite beds.	533 (.016)	36.4
4050 (6/26/88)	NW¼, NE¼, Sec. 8 T4N, R4E 744,705 N 1,128,580 E	Representative rock chip sample from blocks at mouth of prospect adit; mineralized Deadwood hornfels and quartzite; gossanous replacement of carbonate beds. Green cu oxide after chalcocite.	124	2.8
4051 (6/28/88)	NE¼, NE¼, Sec. 7 T4N, R4E 744,270 N 1,125,810 E	Representative rock chip sample, blocks in prospect pit; Deadwood quartzite, fractured with veinlets of limonite after sulfides; 3-5 vol. % sulfides.	78	6.6
4052 (6/29/88)	SW¼, NW¼, Sec. 36 T5N, R3E 754,750 N 1,118,125 E	Representative chip sample dump of prospect adit; oxidized mineralized Deadwood quartzite with minor dolomite, with clots and blebs of gossanous limonites.	323 (.010)	3.5
4053 (6/29/88)	SW¼, NW¼, Sec. 36 T5N, R3E 754,455 N 1,118,325 E	Slightly higraded chip sample,dump of prospect adit; very weakly mineralized Deadwood quartzite and hornfels; mainly diopsidic calc-silicate hornfels with weak limonites after sulfides.	44	0.3
4054 (6/29/88)	SW¼, NW¼, Sec. 36 T5N, R3E 754,230 N 1,118,340 E	Chip sample of gossanous material stockpiled at dump of prospect adit; mineralized Deadwood hornfels, strong sulfide mineralization.	425 (.013)	0.7

GEOCHEMICAL SAMPLE DATA SHEET

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Rock Chip Samples collected by R.L. Nielsen, November - December 1987, April - June 1988

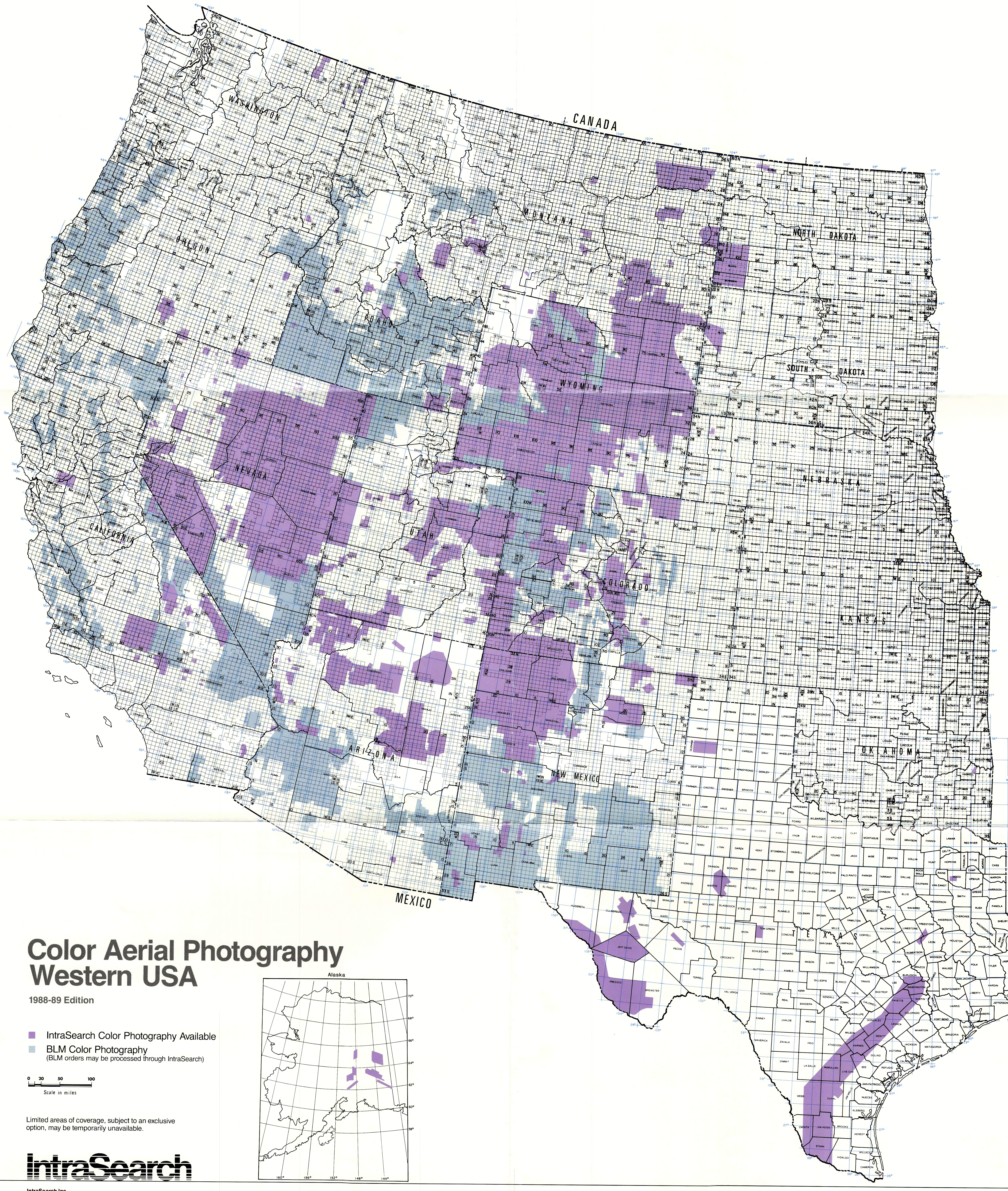
SAMPLE NUMBER	LOCATION	SAMPLE DESCRIPTION	Au ppb (oz./ton)	Ag ppm
4055 (6/29/88)	SW¼, NW¼, Sec. 36 T5N, R3E 754,090 N 1,118,270 E	High grade chip sample dump of prospect adit; Deadwood quartzite and hornfels; weakly mineralized with disseminated sulfides, now oxidized.	283	1.8
4056 (6/29/88)	NW¼, NW¼, Sec. 36 T5N, R3E 755,165 N 1,118,260 E	Representative chip sample, dump of prospect adit, weakly mineralized Deadwood hornfels, mainly dolomitic siltstone with a little limonite on fractures.	20	0.4
4057 (6/29/88)	NW¼, NW¼, Sec. 36 T5N, R3E 755,590 N 1,118,025 E	Representative chip sample, dump of prospect pit; weakly mineralized Deadwood quartzite with red and ocherous limonites in quartzite matrix; in contact with altered and mineralized porphyry.	20	0.4
4058 (6/29/88)	NW¼, NW¼, Sec. 36 T5N, R3E 755,800 N 1,118,245 E	High grade sample of mineralized Deadwood from dump of prospect adit; Deadwood hornfels, largely dolomitic siltstone, largely unaltered but local gossanous replacement of dolomite.	1351 (.039)	8.7
4059 (6/29/88)	NW¼, NW¼, Sec. 36 T5N, R3E 755,930 N 1,118,260 E	Rock chip sample dump of prospect adit, representative of mineralized material, Deadwood hornfels and quartzite, heavy replacement and impregnation with limonites after sulfides.	7600 (.218)	2.0
4060 (6/29/88)	SW¼, SW¼, Sec. 7 T4N, R4E 756,265 N 1,118,265 E	Rock chip sample, select mineralized material from dump of prospect pit; Deadwood hornfels, some silstone beds replaced by gossanous limonites.	183	1.7

GEOCHEMICAL SAMPLE DATA SHEET

PROJECT: GILT EDGE AREA, MAPPING AND RECON.

Rock Chip Samples collected by R.L. Nielsen, November - December 1987, April - June 1988

SAMPLE NUMBER	LOCATION	SAMPLE DESCRIPTION	Au ppb (oz./ton)	Ag ppm
4061 (6/30/88)	SE¼, SE¼, Sec. 6 T4N, R4E 746,060 N 1,125,930 E	Representative rock chip sample of exposure in cut for 40'. Mineralized and brecciated Deadwood hornfels, hydrothermal breccia and disseminated pyrite. Fragments of Deadwood quartzite and hornblende trachyte porphyry in a quartz pyrite matrix.	251	3.9
4062 (6/30/88)	SE¼, SE¼, Sec. 6 T4N, R4E 745,400 N 1,125,790 E	Rock chip sample 50 feet along cut; bedrock poorly exposed. Shaley part of Deadwood hornfels; very strongly fractured and heavily impregnated with jarosite; strong clay alteration.	501 (.015)	2.4
4063 (7/1/88)	NW¼, NE¼, Sec. 8 T4N, R4E 744,230 N 1,129,080 E	Representative chip sample, dump of prospect adit; Deadwood quartzite, heavily impregnated with limonite after sulfides, some gossanous pods and layers.	32	2.4



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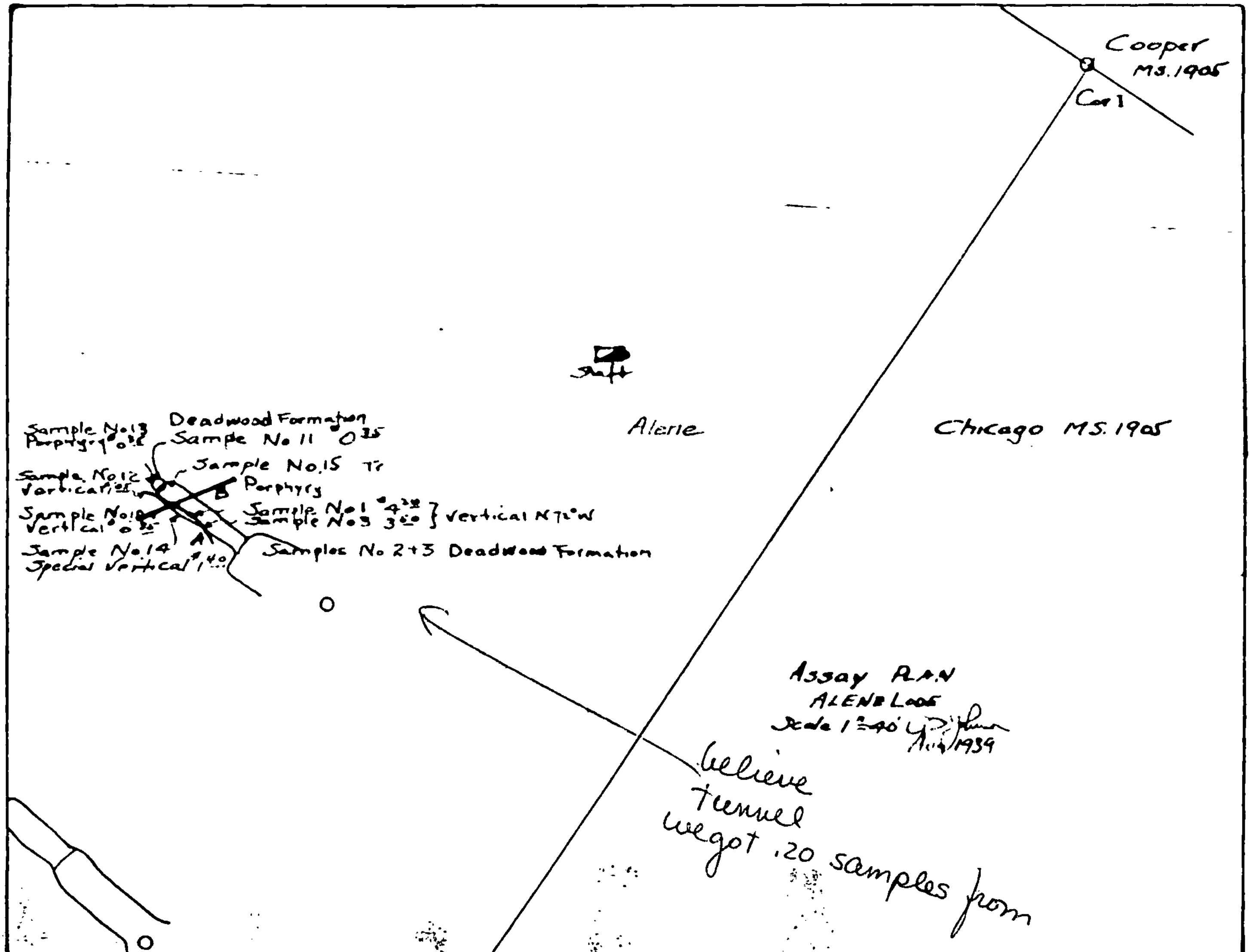
A Summary of the Geology and Mineralization in the Lead-Deadwood area, Black Hills, South Dakota

Gilt Edge Inc.

Rod MacLeod

2/18/85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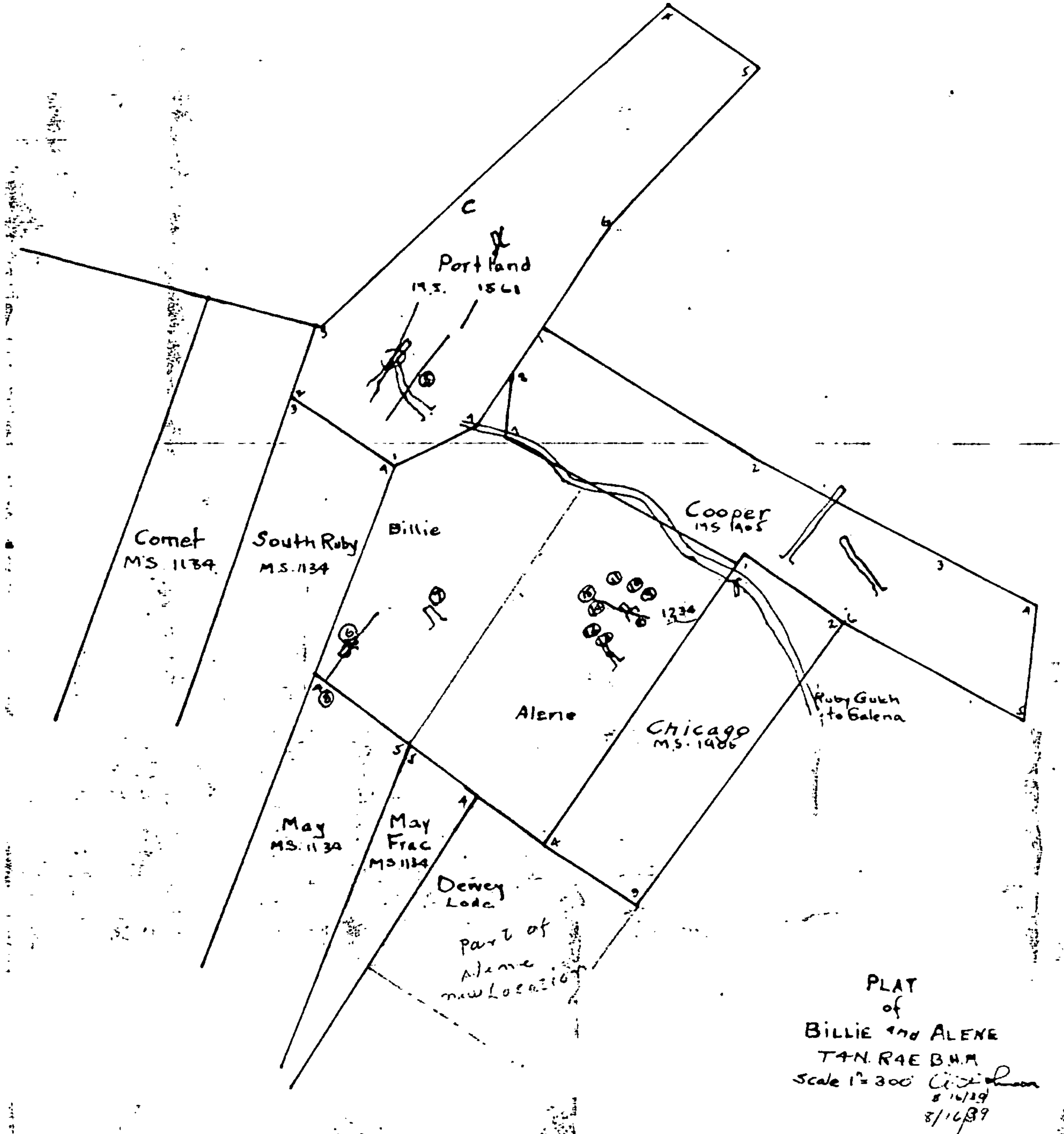

Our Last Chances

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Introduction

Mining in the Black Hills of South Dakota and Wyoming dates back to approximately 1876 following the discovery of gold near Custer, S.D., during the 1874 expedition of General Custer through the Black Hills. Although gold and silver have historically (and presently) been the most important commodities produced from the mines in the Black Hills, other mineral production has been quite diverse for an area of such relatively small extent. Industrial non-metallic materials have been mined from Paleozoic and Mesozoic sediments and Precambrian pegmatites, producing limestone, gypsum, iron ore (Portland cement and aggregate), bentonite (steel), feldspar (porcelains, etc.), spodumene (Li), mica (Cs, Li, and vermiculite), and quartz. By-products from pegmatite mines have also included such commodities as beryl, columbite-tantalite, and tin. Production of metallic commodities from mines in rocks ranging in age from Precambrian to Tertiary have included Au, Ag, Pb, Zn, and W.

Current and historic production of Au and Ag has largely been from mines in the northern Black Hills centered around the towns of Lead and Deadwood. Although the Homestake Mine has been the single largest producer of gold and silver (about 36,000,000 oz Au and 7,000,000 oz Ag) from the Precambrian Homestake formation, significant production, summarized in Table 1, has also come from Paleozoic sedimentary rocks and Tertiary igneous rocks.

This paper is an attempt to outline 1.) the characteristics of the Precambrian metamorphic rocks, Paleozoic sediments, and Tertiary igneous rocks; 2.) the controls of Au and Ag mineralization; and 3.) the distribution of Au and Ag mineralization as it is found in the Lead-Deadwood area.

Table 1. - Gold production of the Black Hills, 1875-1971

Mine or locality	Location	Principal source of ore[1]	Gold produced (in troy ounces)[2]
Principal mines:			
Homestake	At Lead, Lawrence County	pꞒif	31,446,997
Golden Reward group of mines	2 mi. (3 km) SW. of Lead	Ꞓdd	[3]950,000
Bald Mountain group of mines	3 mi. (5 km) W. of Lead	Ꞓdd	[4]836,000
Mogul	3 mi. SW. of Lead	Ꞓdd	[5]350,000
Placers of Deadwood region	Near Deadwood	QTp	[6]200,000
Maitland (Penobscot)	3 mi. NNW. of Lead	Ꞓdd	147,000
Wasp No. 2	2 mi. S. of Lead	Ꞓdd	[7]120,000
Keystone and Holy Terror	At Keystone, Pennington County	pꞒq	86,000
Gilt Edge	5 mi. (8 km) ESE. of Lead	Ti	56,000
Spearfish Gold	7 mi. (11 km) W. of Lead	Mp	[8]45,464
Clover Leaf (or Uncle Sam)	At Roubaix, 7 mi. SE. of Lead	pꞒq	43,385
Lundberg, Dorr, and Wilson	2 mi. WSW. of Lead	Ꞓdd	43,617
Hoodoo-Union Hill	5 mi. ESE. of Lead	Ti	[9]30,000
Reliance	5 mi. W. of Lead	Ꞓdd	27,003
Rockerville placers	Just E. of Rockerville, Pennington County	QTp and Ꞓdc	[10]20,000
Ragged Top	6 mi. W. of Lead	Mp	15,800
Deadwood Standard	7 mi. W. of Lead	Mp	11,953
J.R.	3 mi. N. 60° E. of Hill City, Pennington County	pꞒq	11,500
Hidden Fortune	Just N. of Lead	Ꞓdd	10,997
Other deposits:[11]			
Lawrence County (especially Alder Creek, Cleopatra, Bismarck, Golden Crest, Monarch, and Kicking Horse).[12]		Ꞓdd	50,000
Pennington County (especially Empire, Bullion, Standby, and Sunnyside).[12]		pꞒif and pꞒq	30,000
Custer County		pꞒq	4,000
Total production from identified sources			34,536,246
Production from unidentified sources			158,306
Total recorded production			34,694,552

[1] pꞒif, Precambrian iron-formation; pꞒq, quartz veins in Precambrian metamorphic rocks; Ꞓdc, conglomerate at the base of the Deadwood Formation; Ꞓdd, replacement bodies and veins in dolomite and other rocks of the Deadwood Formation; Mp, Pahasapa Limestone; Ti, Tertiary igneous rocks; QTp, Quaternary and Tertiary placer deposits.

[2] Chief source of information is Allsman (1940); other sources (except for the Deadwood and Rockerville placers) are U.S. Bureau of Mines Minerals Yearbooks, Reports of the South Dakota State Mine Inspector, Slaughter (1968, p. 1435), U.S. Bureau of Mines (1954, 1955), Irving (1904, p. 117-118), and Shapiro and Gries (1970, p. 190-194). Many figures are in part estimates, several of which are based on published statements of the probable dollar value of production during years prior to 1900 for which no exact records exist; other estimates, for years after 1937, were obtained by subtracting the published or probable production figures of other mines from the total South Dakota production in that year.

[3] Allsman (1940, p. 38-39) recorded production from the Golden Reward for 1901-11 as only 371,382 ounces of gold and 734,223 ounces of silver, but he stated that incomplete records for earlier years suggest a total production of about $21 million in bullion. This large total implies that the Golden Reward gold production cannot have been less than the 950,000 ounces used here, which makes the Golden Reward group of properties the second largest source of gold in the Black Hills. The Bald Mountain group of mines has traditionally been regarded as holding the second ranking position, and tradition may well be correct, for its production of 836,000 ounces is almost completely documented.

[4] The production of the Bald Mountain group of mines is the total of (1) 487,877 ounces for 1901-37 published by Allsman (1940, p. 28); (2) about 342,000 ounces for 1938-59 either known or readily deduced as coming from the Bald Mountain operation from U.S. Bureau of Mines Minerals Yearbook figures and from Slaughter (1968, table 1); and (3) apparently small production prior to 1901, of which only an estimated 5,700 ounces from the Clinton and Dividend properties seems to be recorded (Irving, 1904, p. 118). This brings the total, in round figures, to 836,000 ounces. Unfortunately, Miller (1962, p. 114-115), whose data should be authoritative, gives figures that (after subtracting the Mogul production, which is here treated separately) total only 757,858 ounces. Miller and Allsman are substantially in agreement for the period 1901-37. The main discrepancy lies in the 1938-59 figures, for which Miller seems to use 271,561 ounces instead of the 342,000 ounces used here.

[5] Allsman (1940, p. 38) recorded production of 212,679 ounces for 1902-17. He also said that scattered records indicate about $3 million in bullion produced in earlier years. This amount, after allowance is made for silver, suggests 138,000 ounces of gold, which brings the total gold production, in round figures, to 350,000 ounces.

[6] Bergendahl (1964, p. 44). Source of information is unstated, but oral communications with him and A.H. Koschmann during the late 1950's, when they were compiling gold production data from many sources, suggest that this figure is based on U.S. Mint records of gold receipts from this region during years when the only large production was from placers at Deadwood.

[7] Allsman (1940, p. 40) recorded 100,819 ounces for 1901-20 and said that $500,000 or less was produced in earlier years, which indicates a total of about 120,000 ounces.

[8] Omits Allsman's figure of 3,150 ounces for 1899, which according to Shapiro and Gries (1970, p. 167) came mostly or entirely from elsewhere.

[9] The Hoodoo-Union Hill deposits (Allsman, 1940, p. 63) had a production of at least $150,000 in gold, and the company owning the property produced $800,000 from this and other sources. The 30,000-ounce estimate used here is nearer the larger figure than the smaller one.

[10] Parker (1966, p. 87) seems to be the only author who has ventured an estimate of the Rockerville production, which, without citing a source, he places at $400,000 in 1877 and 1878 and at more than $500,000 within a few years thereafter. The amount of disturbed ground in Rockerville Gulch and along the base of the Deadwood Formation suggests that production was indeed substantial, but it was probably not as large as Parker states. The estimate of 20,000 ounces used here is merely a guess but probably is as accurate as any that can be made now.

[11] None of the hundreds of small placer deposits mined after the gold rush years are included.

[12] Mines specifically named are those that have a recorded or estimated production of between 3,000 and 10,000 ounces.

Geology of the Precambrian Metamorphic Rocks

The "Lead-Deadwood Window" is an exposure of Precambrian metamorphic rocks that consist of over 15,000 feet of detrital and chemical sediments and lesser amphibolites or meta-basalts (Fig. 1). The metasediments were probably deposited originally in a subsiding basin or eugeosynclinal environment and range between 2.1 b.y. to 1.7 b.y. old. Detailed descriptions of the stratigraphy in this area have been published by Bayley (1970), Noble and Harder (1948), and Slaughter (1968), to which the reader is referred for additional information.

The lowest unit in the Precambrian stratigraphic sequence, is the Poorman formation. It is at least 2000 feet thick, but the base is not exposed, so the exact thickness is not known. The Poorman is largely a laminated, dark grey phyllite. Mineralogically, it is comprised of quartz, sericite, graphite, iron oxides, and ankerite in order of decreasing abundance.

The Homestake formation lies conformably on the Poorman formation and ranges from 200 to 300 feet thick. Outcrops of the Homestake are generally reddish-brown, but in the Homestake Mine, they are more commonly green-brown to green. It is a fine-grained, bedded Mg-siderite (sideropleisite)-quartz or a cummingtonite-quartz schist depending upon metamorphic grade. It is comprised of cummingtonite (or Mg-siderite), quartz, biotite, chlorite, and graphite. The quartz occurs as pods or lenses of recrystallized chert. The original sediment probably consisted of alternating layers of Mg-siderite and chert; i.e., a carbonate facies iron formation. This metasedimentary unit is repeated as thin discontinuous beds or lenses in the upper Poorman formation, lower and upper Ellison formation, and in the Flag Rock formation.

The Ellison formation conformably overlies the Homestake formation and ranges from 3000 to 5000 feet thick. It has been divided into a lower

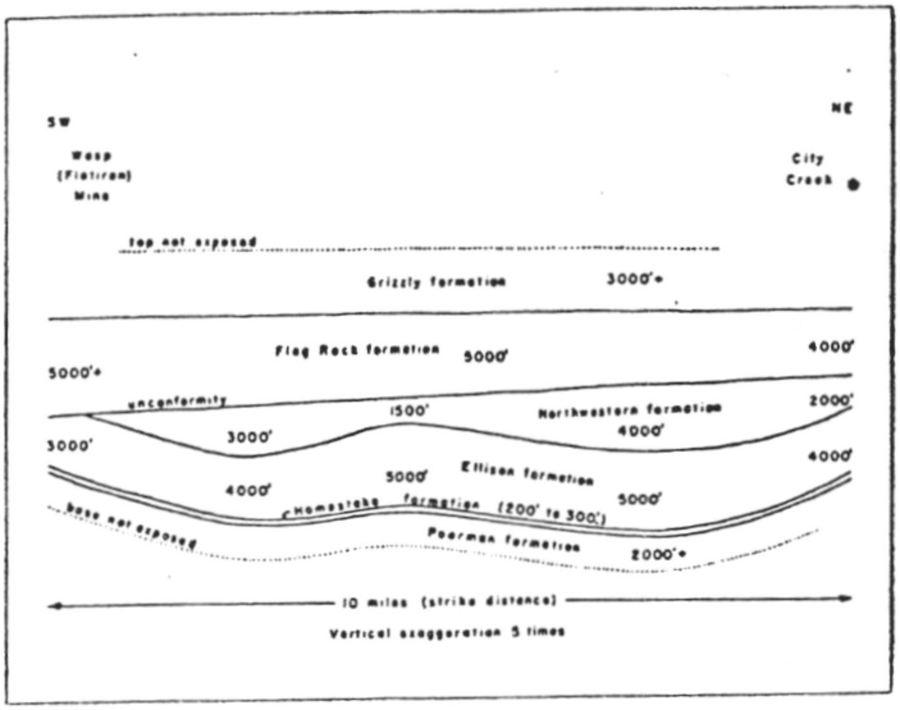

Figure 1. - Stratigraphic column of the Precambrian rocks in the Lead-Deadwood area.

member consisting of quartzites and phyllites (approximately 1200 feet thick), a middle phyllite member (approximately 1500 feet thick), and an upper quartzite and phyllite member (between 1200 and 2000 feet thick). Laminations and banding in the phyllites are not as common as found in the Poorman formation and the quartzites are generally massive. Phyllites consist of mostly quartz and muscovite with minor biotite and ankerite. Quartzites consist largely of quartz, graphite, iron oxides, sericitic muscovite and minor ankerite.

Conformably overlying the Ellison formation is the Northwestern formation which is as much as 4000 feet thick. The formation consists largely of phyllite and schist which shows no bedding or layering. Mineralogically, it is comprised of quartz, sericitic muscovite, biotite, and minor tourmaline and sphene. The formation thins to approximately 2000 feet north of Deadwood, and disappears entirely to the south of Lead.

The Flag Rock formation rests unconformably on the Northwestern formation or the Ellison formation where the Northwestern is absent. The Flag Rock is a heterogeneous sequence of largely light gray sericitic phyllite or schist, streaky quartzite and/or metachert, cherty ferruginous schist and amphibolites (metabasalts); the latter having been included in the formation by Bayley (1970). The formation is as much as 5000 feet thick. Thy phyllite and schist is comprised of quartz, muscovite, graphite, iron oxides and minor tourmaline. Streaky quartzites and metacherts are comprised of largely quartz with 1 mm to several cm dark gray bands of quartz, graphite, iron oxide and minor muscovite and tourmaline. Cherty ferruginous schist is comprised largely of quartz, iron oxide and muscovite. In outcrop this unit is reddish brown and much of the iron oxide is hematite, but in the subsurface the iron oxide is a mixture of hematite and magnetite. The amphibolites (metabasalts) are dark green-gray to black, fine-grained rocks that are commonly comprised of flattened and elongated ellipsoids (pillows). Mineralogically they are comprised of hornblende and plagioclase.

The Grizzly formation is conformable with the Flag Rock formation and is at least 3000 feet thick; the top of the formation is not exposed. It is comprised of graywackes and quartz-mica schists in the Roubaix area, but these grade into largely quartz-mica schist and phyllite or slate near Lead. These rocks are largely comprised of quartz, muscovite and minor biotite, garnet, iron oxides, and tourmaline.

The Precambrian metasediments in the "Lead-Deadwood Window" are strongly deformed by at least two periods of folding (Noble et. al., 1949) and form an anticlinorium that plunges 25° to 30° to the southeast. This anticlinorium is a series of early isoclinal folds with a steeply dipping, north-northwest trending axial plane foliation. The early folds are cross-folded by tight, northwest trending folds which produced zones of dilation. Cross-folded folds are apparent in plan and cross-section and crenulated foliation and lineations are commonly observed in field exposures and hand specimens (Fig. 2). Chinn (1969) determined three periods of deformation in a detailed structural study of the Homestake Mine. In addition, numerous faults and Tertiary felsic dikes crosscut the metasediments.

The garnet isograd bisects the "Lead Deadwood Window" trending north-northwest with biotite grade metamorphism to the southwest and increasing to staurolite grade in the extreme northeastern corner of the window. Studies in Homestake Mine indicate that the isograds dip gently west so that the garnet grade rocks underly those in the biotite zone (Noble and Harder, 1948).

Figure 2. - Structure of the Precambrian Rocks. The Homestake formation is shaded. Poorman formation, pmf; Ellison formation, ef; Northwestern formation, nwf; Flag Rock formation, frf; Grizzly formation, gf. Large Tertiary intrusives are solid black. Large amphibolite bodies are dotted. Faults are shown by dashed lines. Omitted are Cambrian strata, small Tertiary intrusives, small amphibolites, and Tertiary gravel deposits.

Geology of the Paleozoic Rocks

The Paleozoic sedimentary rocks rest unconformably on the Precambrian metasediments. They are comprised largely of shallow marine beach and tidal flat sediments and shelf sediments deposited in the Paleozoic seaway. Figure 3 is a generalized stratigraphic column of the Paleozoic rocks in the Black Hills.

The Upper Cambrian, Deadwood formation is the lower most sedimentary unit. The formation has been subdivided into lower, middle, and upper members by Kulik (1965). The lower member is generally comprised of 0 to 40 feet of basal conglomerate overlain by 10 to 125 feet of quartz arenite or quartzite followed by up to 50 feet of interbedded shales and limestones. This member especially is characterized by rapid facies changes that reflect the paleotopography of the Precambrian surface onto which the sediments were deposited. The basal conglomerate is generally absent and the quartzite the thinnest on paleohighs, such as those formed along the more resistant Ellison formation quartzites adjacent to the less resistant phyllites. Conversely, relatively thick wedges of conglomerate and quartzite were deposited adjacent to these highs and in erosional channels. The middle member of the Deadwood formation is comprised of approximately 100 to 160 feet of interbedded shales, limestones, and intraformational limestone pebble conglomerates. The upper member ranges from 125 to 160 feet thick and consists of massive red (scolithus) sandstone and flaggy sandstones and limestones.

Overlying the Deadwood formation are the Ordovician Winnipeg and Whitewood formations. The Winnipeg is disconformable with the Deadwood, but the Whitewood and Winnipeg are conformable. They range from 85 to 165 feet thick and are comprised largely of shales, siltstones (locally calcareous) and dolomites.

The Devonian-Mississippean Englewood formation disconformably overlies the

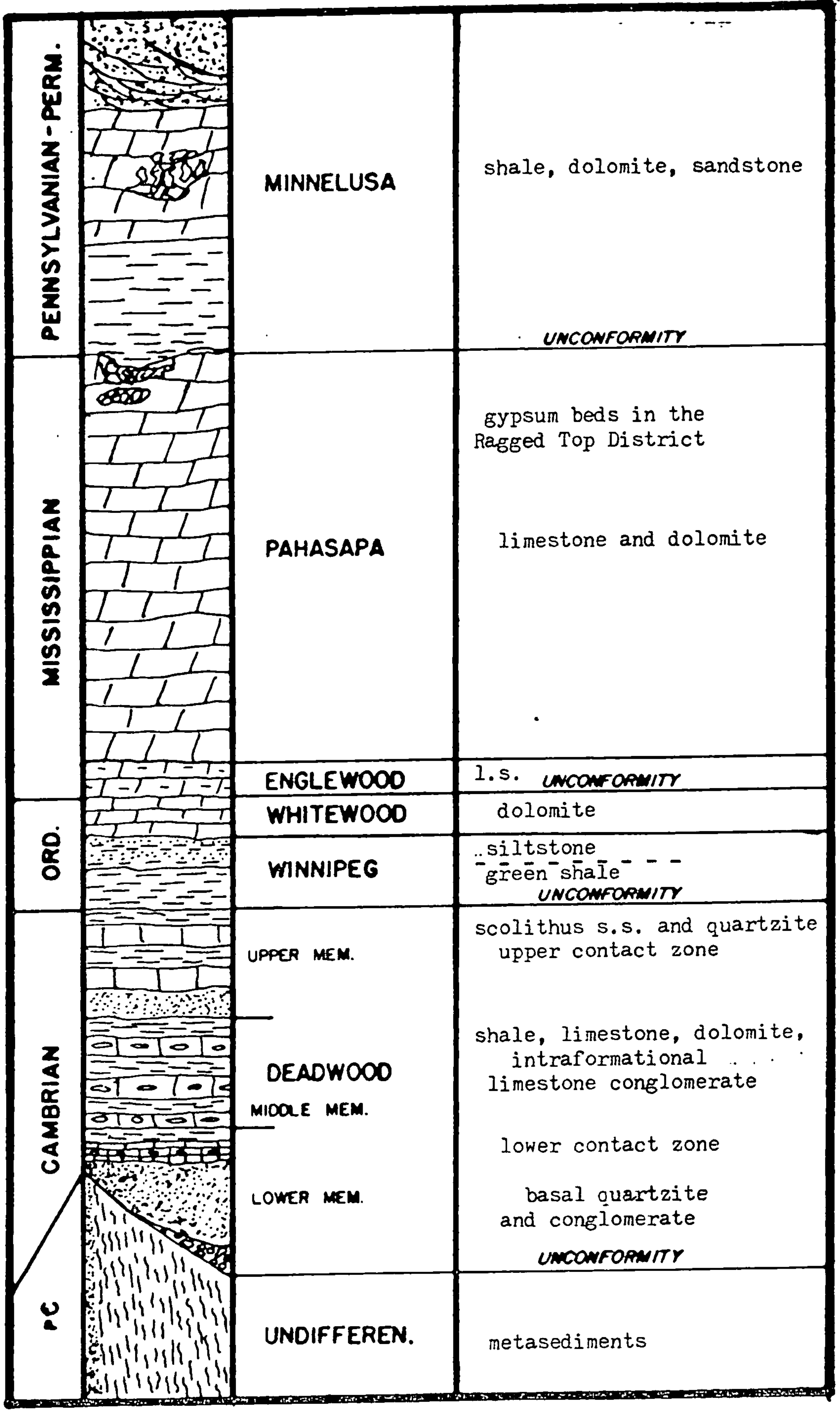

Figure 3. - Stratigraphic column of the Paleozoic rocks in the Lead-Deadwood area.

Whitewood formation. This unit ranges from 35 to 50 feet thick and consists of pink to lavender calcareous siltstone and slabby argillaceous carbonates. The Englewood is conformable with and grades into the overlying Pahasapa formation.

The Pahasapa (Madison) formation is a Mississippean carbonate unit that ranges from 500 to 600 feet thick. It is comprised of crystalline carbonate, argillaceous carbonates that are locally petroliferous, and minor intraformational conglomerates or breccias(?). According to Shapiro and Gries (1970), a pre-Pennsylvania karst topography was developed on the Mississippean surface.

The upper Pennsylvanian-Permian Minnelusa formation unconformably overlies the Pahasapa formation. It ranges from 400 to 500 feet thick and has been subdivided into a lower red shale section, a middle carbonate-gypsum section, and an upper sandstone section. Post depositional dissolution of gypsum and limestone in the middle section has resulted in slump and breccia-like features similar to those that might be developed in karst areas.

Geology of the Tertiary Igneous Rocks

The Tertiary igneous rocks occur in a narrow belt in the northern Black Hills of South Dakota and Wyoming that trends N70° to 75°W. They extend east from Bear Butte to Devil's Tower-Missouri Buttes to the west. According to Lisenbee (1980) they occur along this trend in 13 principal igneous centers and numerous smaller centers (Fig. 4). The intrusives occur as shallow level porphyries emplaced as sills, laccoliths, dikes, and small stocks. In the Lead-Deadwood area, they consist largely of alkaline phonolites, latites, trachytes, and rhyolites and generally range in age from 50 m.y. to 60 m.y. West of the Lead Deadwood area, the intrusives become silica undersaturated phonolites, nepheline and leucite bearing trachytes, and carbonatites that

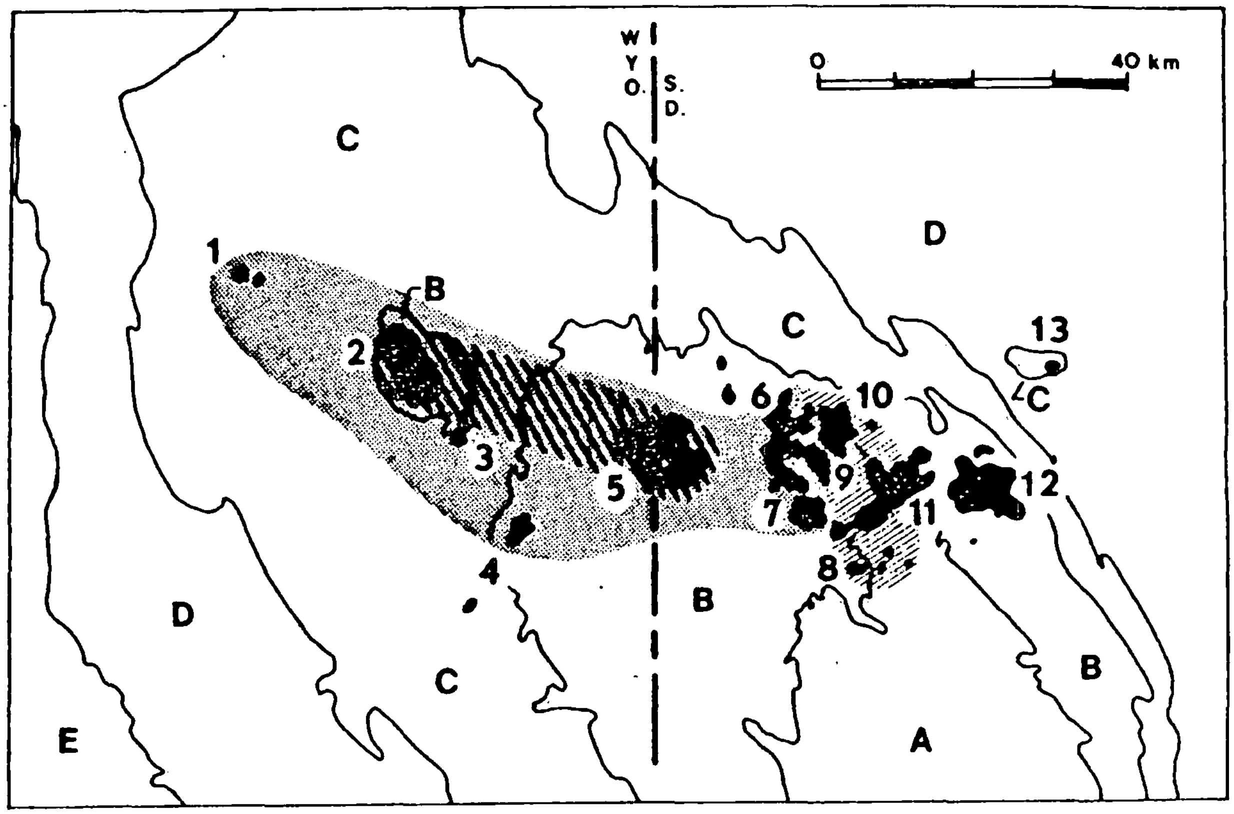

Figure 4. - Tertiary igneous centers and related rock types of the northern Black Hills uplift. Igneous rocks are in black. Stippled pattern indicates centers containing phonolite, heavy diagonal pattern those with carbonatitic affinities and light diagonal pattern those with rhyolite. The centers are: 1) Devil's Tower-Missouri Buttes; 2) Bear Lodge; 3) Sundance Mtn.-Sugarloaf; 4) Black Buttes; 5) Mineral Hill-Tinton; 6) Spearfish-Carbonate; 7) Terry; 8) Strawberry Hill-Tinton; 9) Cutting; 10) Mt. Theodore Roosevelt; 11) Gilt Edge-Galena; 12) Vanocker; 13) Bear Butte. Rock units are: A) Precambrian metamorphic basement; B) Paleozoic sedimentary rocks; C) Upper Permian to pre-Newcastle Sandstone lower Cretaceous sedimentary rocks; D) Cretaceous Newcastle Sandstone to top of Cretaceous sedimentary rocks; E) Tertiary sedimentary rocks.

generally range in age from 40 m.y. to 50 m.y.

The Black Hills form a domal feature that is cored by Precambrian metamorphic rocks which are flanked by Paleozoic and Mesozoic sedimentary rocks that gently dip away from the core. The dome has been subdivided into two structural domains by Noble et. al. (1949) along a north trending lineament through Newcastle, Wyoming. The domains consist of a north-northeast trending domain east of the lineament and a northwesterly trending domain on the west. Figure 5 crudely shows these domains as they are reflected in the structural data. Lisenbee (1980) postulates that uplift started as early as late Cretaceous and continued until middle Tertiary time.and that igneous activity is coeval with doming.

Gold and Silver Deposits

Precambrian

The most significant gold mineralization in rocks of Precambrian age, occurs in the Homestake formation of the Lead-Deadwood Window and in Homestake-like amphibolites (cummingtonite-grunerite schists). Minor Au mineralization also occurs in quartz veins and metaconglomerates. Of particular significance is that the majority of Precambrian gold mines occur in rocks that have been metamorphosed to at least garnet grade.

At the Homestake Mine in Lead, S.D., gold ore is virtually confined to the Homestake formation. The formation is extremely variable in thickness being thinned or even pinched out on fold limbs and thickened at fold noses. Therefore, much of the production comes from zones of dilation generally located at fold noses. Gold occurs as native gold that is comprised of approximately 82% Au, 17% Ag and 1% other metals and occurs with auriferous arsenopyrite, pyrrhotite, and graphite. Currently, the ore averages about .17 opt Au. Models that are currently being used for the Homestake deposit

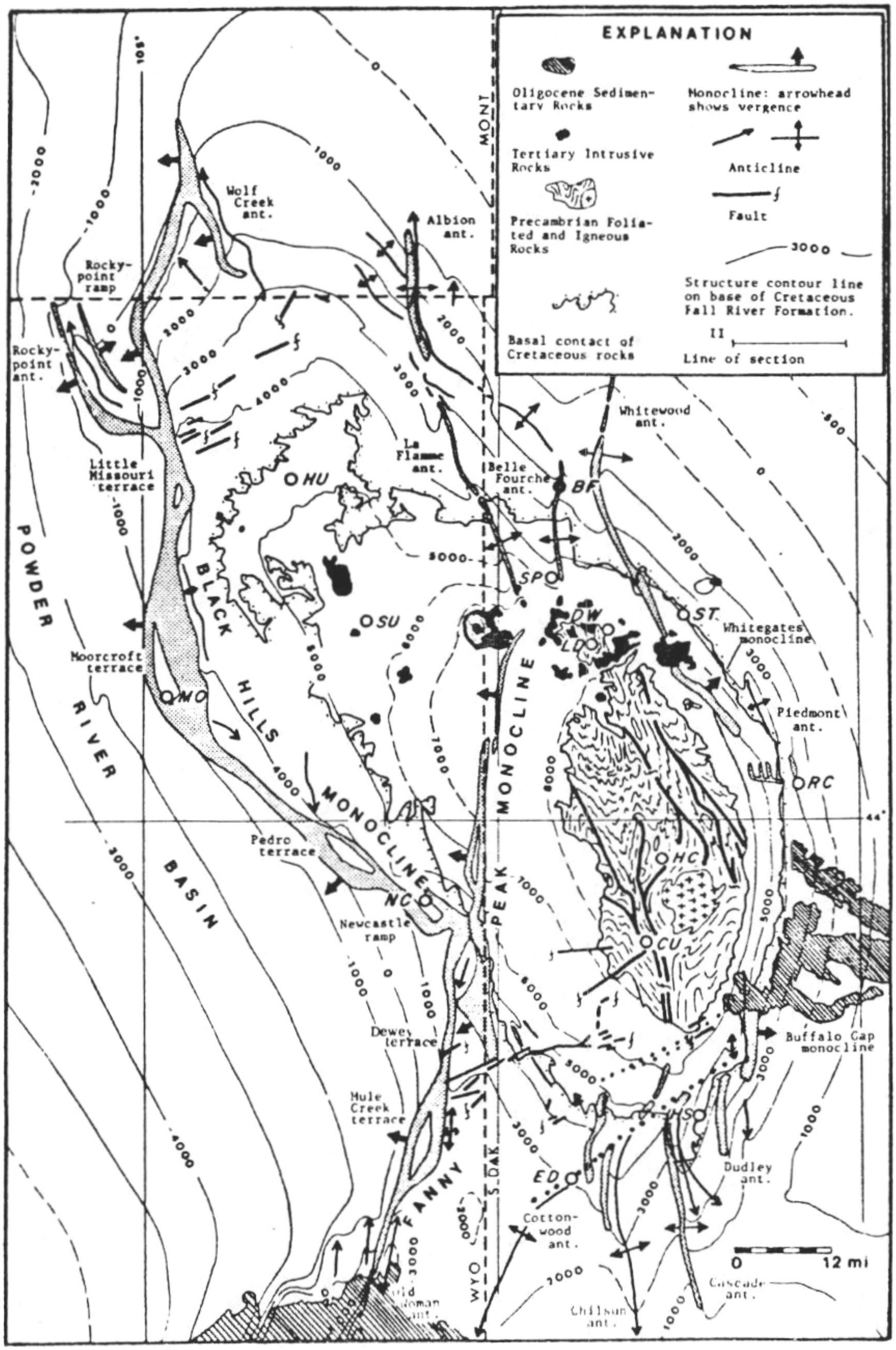

Figure 5. - Tectonic map of the Black Hills region

suggest that it is syngenetic, deposited with an exhalative carbonate iron formation; perhaps associated with distal volcanic activity or exhalative hot spring activity (Rye and Rye, 1974; Hallinger, 1980±). Past workers have postulated that gold was remobilized and concentrated in zones of dilation at fold noses. Hallinger (1980±) has suggested on the basis of geochemical modeling that little if any remobilization took place, but if this is true it is difficult to explain why gold mineralization only seems to occur in rocks that have been metamorphosed to garnet grade.

Other areas of gold production from Homestake-like iron formations include the Rochford area (Standy Mine, Cochran Group), the Keystone area (Bullion Mine), and the Tinton area. These areas have recently gone through a flurry of exploration by HMC, Getty, and Freeport with at least marginal success by HMC in the Keystone area.

Paleozoic Rocks

Paleozoic rocks in the Lead-Deadwood area have historically been the second largest source for production of Au and Ag ores (Table 1). These deposits are generally considered to be Tertiary age, being intimately related to Tertiary igneous activity and therefore, restricted to the northern Black Hills. In general, they occur as replacement deposits in carbonate units along vertical fractures that intersected carbonate or carbonate bearing sediments. Au:Ag ratios tend to be in the range of 1:2 to 1:3, and silicification is a common, if not a ubiquitous feature of these deposits. The majority of production has come from ore bodies in the Cambrian Deadwood and the Mississippean Pahasapa formations.

Production from the Deadwood formation has largely come from sandy dolomites just above the lower quartzite and from carbonates just below the quartz sandstone in the upper member. These mineralized horizons are referred to locally as the "lower and upper contact zones" and generally range from about 1 to 10 feet thick. The carbonates are largely replaced by silica, pyrite, argentiferous galena, gold tellurides, and native gold and silver. Ore bodies are developed along vertical fractures that are documented to have strike lengths up to 2700 feet with mineralization occurring at several carbonate horizons along fracture intersections with carbonates. Closely spaced fractures associated with mineralization, such as at the Bald Mountain Mines, make near surface deposits amenable to open pit mining methods. The ores are described by Smith (1897) to have occurred as oxidized ("red ore") or as sulphide ("blue ore"). The gold and silver were generally easy to extract from the oxidized ores, while sulphide ores (Au tellurides) required roasting. In addition, some production has come from replacement ore bodies in the carbonates of the middle member which hosts the Au and Ag ore at the currently producing Annie Creek Mine. Finally, ore bodies in the basal conglomerates are paleoplacers deposited along paleohighs adjacent to the Precambrian Ellison and Homestake formations. Irving (1904) stated that the ores commonly occurred as "pay streaks" where gold was probably concentrated by channel currents.

As in the Deadwood formation, ore bodies in the Pahasapa formation occur along vertical fractures in silicified (and dolomitized) carbonates. Although production has come from various levels within the formation, much of the production seems to have come from the upper 150 feet and rarely contains any significant sulphide. Recent work by HMC in the Ragged Top Mining District indicates that mineralization is hosted in a silicified and/or dolomitized "breccia horizon" that is within 100 feet of the surface, ranging from 5 to 50 feet thick. Though the origin of these breccias is still open to debate, they probably formed due to the dissolution of gypsum beds near the top of the formation. Mineralization of the "breccias" was later controlled during the Tertiary by fracturing.

Production of Au and Ag from the Winnipeg, Whitewood and Englewood formations has been minor and there is no recorded production from the Minnelusa formation. These formations should be good hosts for mineralization that could be explored for potential deposits.

Tertiary Rocks

Au and Ag production from Tertiary igneous rocks has historically come mostly from the Gilt Edge group of mines near Galena and the Cutting Mine north of Lead. At both locations, brecciated porphyries host mineralization. Recent exploration by St. Joe in the Richmond Hill area indicates that other porphyry centers may host Au and Ag mineralization.

Mineralization Controls

Factors that seem to control Tertiary Au and Ag mineralization are enumerated below. Although the list is not considered to be complete, it provides some factors to be considered in an exploration program.

1.) Fracturing, fracture zones and brecciation associated with Laramide doming of the Black Hills and Tertiary Intrusive activity (ground preparation) seems to be a prerequisite to mineralization (fracturing is not radial around the "Lead-Deadwood Window"). In areas such as Bald Mountain northwest of Lead, fracturing and mineralization are closely spaced and production of relatively large tonnages occurred. In the Galena Mining District (Ag and Pb) mines were often developed along a single vertical fracture or fracture zone that may have produced high grade ores, but the tonnages produced were generally small. The ability to predict where other highly fractured areas might occur could assist in the attempt in locating other deposits similar to Bald Mountain.

2.) Ore grade mineralization hosted in Tertiary igneous rocks occurs in breccias that are probably related to shearing associated with multiple igneous intrusions. At Gilt Edge, the shears are best developed along a $N35^{\circ}E$ to $N45^{\circ}E$ trend.

Flat lying "breccias" that host mineralization in the Pahasapa formation (Ragged Top District) are best developed within the upper 150 feet of the formation. According to Jennings (1985, personal comm.) a karst topography did develop at the top of the formation, but karst features rarely, if ever, host mineralization because of recementing prior to mineralization. The current model being used by HMC for the deposits at Ragged Top proposes that the "breccias" formed due to the dissolution of gypsum rich beds near the top of the formation and mineralization occurred within these beds along fractures that intersected them. The ore is commonly silicified and/or dolomitized and contains no primary sulphides.

Ground preparation other than fracturing is not documented (if it exists) for ores located in the Deadwood formation. The preponderance of the ores in at least the "lower contact zone" seems to be directly related to the thickness of the carbonates above the lower quartzite, fracture intensity and extent, and the proximity of igneous activity. The thickness of the carbonates above the lower quartzite is probably related to fluctuations in sea level during deposition. Local differences in sea level would have been caused due to the influence of paleotopography on the Precambrian surface. Because carbonates tend to be deposited in relatively shallow water, it seems likely that carbonates should be thickest over paleohighs (e.g., those highs developed over the p€ Ellison formation quartzites adjacent to the phyllites) and pinch out in deeper basins formed over less resistant phyllites and schists. Gold deposits found in the basal conglomerate were certainly controlled by paleotopography, and the influence of paleotopography on sedimentation would have probably continued until basins were filled by sedimentation.

Finally, at least two and possibly three periods of silicification are common to all Tertiary ore deposits. Although the role of each period has not been documented, silicification appears to have at least accompanied mineralization and early periods of silicification may have influenced Au and Ag deposition.

3.) The proximity of favorable host rocks, fracturing, and Tertiary igneous activity to a metal source may have controlled the distribution of the Tertiary ores. Plate I shows the distribution of mining districts surrounding the "Lead-Deadwood Window". Although other sources cannot be precluded, the distribution of the mining districts suggests that the Homestake formation is the most likely source of Au and Ag in Tertiary ores. Rye and Rye (1974) did a stable isotope study in the northern Black Hills; mostly to determine the character of the Homestake formation, but the possible influence of the Tertiary intrusives was also considered. Their work indicates that the hydrothermal fluids responsible for depositing sulphides in the Tertiary ores obtained sulfur from the primary sulphides in Precambrian rocks. They also showed that meteoric water played an important, but probably not a singular role, in Tertiary mineralization. Norton (1983), on the basis of similarities in chemistry, argues that the constituents for the Tertiary ores and gangues were derived from the chemically similar constituents found in the Homestake formation.

Summary

The Homestake Mine produces gold from the high folded Precambrian Homestake formation. Gold is considered to be syngenetic with the deposition of a carbonate iron formation (Homestake formation) and was subsequently concentrated in fold noses during folding and metamorphism. Precambrian gold deposits in the Black Hills are generally found in rocks that have been metamorphosed to at least garnet grade; at the garnet isograd, the Homestake formation becomes a cummingtonite-quartz schist.

Tertiary Au and Ag deposits largely occur in the Cambrian Deadwood and Mississippean Pahasapa formations, but significant production has also come from brecciated Tertiary intrusive rocks. In Paleozoic sediments, the Au and Ag mineralization occurs as replacement deposits in carbonate units associated with two (possibly three) periods of silicification and high angle fractures that cut the carbonates. Tertiary ore deposits are intimately related to Tertiary igneous activity and Au and Ag were probably derived from the Precambrian metasediments. High angle fracturing that seems to control mineralization is probably related to Laramide doming as well as Tertiary intrusive activity. Additional Au and Ag deposits could possibly exist in both Paloezoic sediments and Tertiary igneous rocks north and east of the "Lead-Deadwood Window" where the Precambrian rocks disappear under Paleozoic sediments.

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SECTION 36 STRATIGRAPHY

Thtp sill

"BASAL" quartzite (30-50')

Sill - quartz monzonite (100')

Quartzite 40' discontinuous

Sill -100'-120 quartz monzonite

Shale, dolomite 30' or so

Sill quartz monzonite 80' + 40' of Єd shale + Sill 80'

Top shale 30-40' of Єd + Ow ss & green sh (20')

382 - 1080-1085 - @ 9:30

~10'/hr.

DATE: MARCH 3, 1988

TO: R.L. OUTZEN

FROM: J.N. BARRON

SUBJECT: PROPOSED DEVELOPMENT AND EXPLORATION TARGETS

Numerous opportunities for reserve expansion beyond the planned oxide mining phase exist at our Gilt Edge properties. Earlier this year we were able to show the potential for deep mineralization based on a few past drill holes. Based on this information and the most comprehensive geologic compilation ever completed on the project, we have identified several targets which appear likely to add reserves to those currently identified. These target areas are shown on the accompanying maps and are based on current geologic information. The "confidence level" which we can assign to these various targets, as to the likelihood of adding new reserves, of course, diminishes outward from the area of proven/probable reserves because of comparative lack of information in those areas. However, the geologic relationships of structure, favorable rock types, alteration, and the presence of gold in drill and/or surface samples make these areas prime targets for further exploration. Indeed, some of the best "hunting ground" lies immediately adjacent, both at depth and laterally, to the proposed "28 MMT Sulfide Pit" developed by Wright Engineers, Ltd.

Three maps accompany this report. Map 1 is at a scale of 1"=100' and shows current drill hole locations, outlines of the quartz trachyte porphyry stocks and trachyte porphyry in color and uncolored Deadwood Fm. and pC rocks (lumped). Based on the presently developed geologic model, favorable structural zones, presence of strong alteration and gold values from surface samples, close-in or proximal targets have been identified. These targets are briefly described in Table 1. These target areas are 1) Deep Sulfide Target, 2) North Strawberry/Anchor Hill, 3) Langley, 4) Langley Extension, and 5) Hoodoo. This map also shows the proposed approximate 200' x 200' drilling in the North Strawberry/Anchor Hill area. Much of the drill-indicated and inferred ore calculated by Dick Nielsen lies beneath the leach pad which cannot be drilled at this time. However, the geologic potential west of the leach pad and marginal to the Anchor Hill stock in the Deadwood Fm. and contact zone of the stock are targets for this drilling program.

Map 2 is at a 1"=500' scale and shows areas of alteration and surface gold anomalies at levels $\geq$ .1 ppm (blue) and $\geq$ 1.0 ppm or .030 OPT Au (red). This map is intended to depict the widespread nature of favorable alteration and highly anomalous gold mineralization in undrilled areas.

Map 3 outlines the more grass roots or distal targets based on the information shown on Map 2. Proximal targets are those generally defined by some amount of favorable drill intercepts in combination with favorable rock types, structure, alteration and surface gold anomalies >.03 OPT Au (shown in red). Exploration targets shown in blue are undrilled but do show favorable rock types, structural trends, strong alteration and surface gold values >.03 OPT Au (although generally more scattered). Table 2 describes these undrilled, but on all other accounts, favorable exploration areas.

In summary, I'm very excited about these exploration targets. Our present reserve is based primarily on one, relatively small, densely drilled area displaying many of the same geologic and mineralization characteristics seen in the surrounding undrilled areas. I believe there is a high probability of adding significantly to our present reserves with continued work in these areas.

Jim

James N. Barron

JNB/dvl

cc: James A. Anderson,
Ventures Trident

Doug Stewart,
Brohm Mining Corporation

Attachments

TABLE 1
PROPOSED EXPLORATION TARGETS - GILT EDGE PROJECT

AREA/TARGET	PRIORITY	GOLD MINERALIZATION TARGET	GEOLOGIC BASIS	PROPOSED EVALUATION
DEEP SULFIDE TARGET	1	TRACHYTE PORPHYRY PRIMARY HOST ROCK with faulted, brecciated quartz trachyte porphyry, Deadwood Fm. and pC rocks as secondary host rocks.	Highest grade gold ore and most intense alteration is developed in highly brecciated trachyte porphyry marginal to quartz trachyte stocks and plugs and in wide fracture zones (up to 200'+) trending NE and NW. Ore zones in these highly fractured rocks are open at depth. Very good potential for development of 60 MMT+ of sulfide ore at .04 - .05 OPT Au. One of the 1988 drill holes has extended known ore grade gold mineralization at depth more than 800' to the NE along the Rattlesnake Fracture zone.	Deep exploration/development drilling program proposed and initiated. Thirteen rotary holes drilled to date with encouraging results. Drilling program currently on hold awaiting project financing. Phase I of the program was $1.6 MM in order to obtain 200 x 200 feet centers. A second phase of infill drilling based on Phase I results may be necessary to formulate proven/probable reserves.
NORTH STRAWBERRY		CAMBRIAN DEADWOOD FM. PRIMARY HOST ROCK. Strataform and fault-controlled gold mineralization.	Ore-grade gold mineralization developed in basal quartzite and calcareous shale units lateral to north-trending faults. Mineralization is strataform and fault-controlled and generally within 400' of surface. Ore is mostly sulfide. Present drill-indicated and inferred reserves calculated of 3.18 MMT @ .044 OPT with geologic potential of an additional 9.8 MMT at an estimated grade of .04 OPT Au. Gold mineralization up to 125' of .201 OPT Au in highly faulted areas.	Most of drill indicated reserves are present below leach pad. Therefore, infill drilling of this area is not planned at this time. Drilling of geologic potential to west of leach pad is combined with proposed Anchor Hill/North Strawberry infill/exploration drilling program of 40 drill holes (see below).

TABLE 1
PROPOSED EXPLORATION TARGETS - GILT EDGE PROJECT

AREA/TARGET	PRIORITY	GOLD MINERALIZATION TARGET	GEOLOGIC BASIS	PROPOSED EVALUATION
ANCHOR HILL/ NORTH STRAWBERRY	2	CAMBRIAN DEADWOOD FM. PRIMARY HOST ROCK, with faulted quartz trachyte porphyry of Anchor Hill stock as secondary host. Deadwood Fm. breccia marginal to Anchor Hill stock, strataform and fault-controlled gold mineralization.	Limited drilling south of Anchor Hill stock indicates Deadwood Fm. - hosted gold mineralization, generally less than 250' in depth. Up to 55' thick drill intercepts averaging .020-.051 OPT Au present. Strong NE trending gold geochem anomaly with indications of intersection with NW mineralized trend extending from Hoodoo Mine through Union Hill stock to plant site at south end of Anchor Hill. As in the Dakota Maid area, brecciated Deadwood Fm. marginal to the Anchor Hill stock and fault-controlled plus strataform replacement mineralization west of the leach pad in areas of drill indicated reserves are primary targets for proposed drilling program. The Anchor Hill quartz trachyte porphyry contains oxidized and mixed oxide plus sulfide gold mineralization in all three holes drilled in it thus far. The two vertical holes contain 110' and 185' of continuous gold mineralization averaging .046 and .029 OPT Au respectively above depths of 475' in the contact zone.	40 hole rotary drilling program on approximate 200 x 200 foot spacing proposed in order to test the continuity of geologic potential identified west of drill-indicated and inferred reserves under leach pad in Deadwood Fm. The proposed drilling is also formulated to test potential for brecciated, Deadwood-hosted gold mineralization marginal to the Anchor Hill stock as well as quartz trachyte-hosted gold mineralization at the margin and at sites of gold anomalies along inferred structures. Proposed Program: Hole locations shown on 1"=100' scale map. 16,000 feet rotary drilling Total Cost = approximately $320,000 Drilling start-up, based on rig availability, could begin immediately in eastern portion of target area. 10/ves.

TABLE 1
PROPOSED EXPLORATION TARGETS - GILT EDGE PROJECT

AREA/TARGET	PRIORITY	GOLD MINERALIZATION TARGET	GEOLOGIC BASIS	PROPOSED EVALUATION
LANGLEY TARGET	3	TRACHYTE PROPHYRY, DEADWOOD FM. AND pC ROCKS, at the brecciated and faulted margin of the Langley quartz trachyte prophyry stock.	Economic oxide and sulfide gold mineralization is now being developed marginal to the Union Hill quartz trachyte prophyry stock to the north. Grade x thickness relationships display a remarkable aureole around the Union Hill stock margin which is also the source for previously mined high-grade gold ores. Past limited drilling is restricted to the northern margin of the Langley stock. However, this drilling indicates not only shallow oxide, ore-grade gold mineralization, but some of the richest and most continuous gold intercepts drilled on the Gilt Edge property to date, e.g., deep core holes containing 400' to 580' averaging +.08 OPT Au as deep as 1400'. Surface sampling along the eastern, southern and western margins of the Langley stock shows a gold halo similar to the grade x thickness halo surrounding the Union Hill stock, with pods of +.030 OPT Au surrounding the Langley stock. One surface sample was as high as .222 OPT Au. This is a previously undrilled area which begs for exploration drilling in order to make additions to both near-surface oxidized ore and sulfide ore at depth. Favorable areas of mapped brecciation are present at the surface as well as northeast trending fault zones from the Oro Fino shaft on the south to the Hoodoo shaft on the north, along which fault breccia has been mapped.	A drilling program has not been laid out for this area as yet. However, an initial 10-12 drill hole program consisting of both angle and vertical rotary drill holes located in areas of highest surface sample results and mapped zones of brecciation could be formulated and initiated to coincide with the proposed North Strawberry/Anchor Hill drilling program. If results justified further exploration, a second phase of exploration would be formulated. Proposed Program: 6,000 feet of rotary drilling Est. Total Cost = $120,000.00 IP/RES.

TABLE 1
PROPOSED EXPLORATION TARGETS - GILT EDGE PROJECT

AREA/TARGET	PRIORITY	GOLD MINERALIZATION TARGET	GEOLOGIC BASIS	PROPOSED EVALUATION
LANGLEY EXTENSION	4	CAMBRIAN DEADWOOD FM., TRACHYTE PORPHYRY and pC ROCKS. Highly faulted and fractured rocks in which strataform (Deadwood) and fault-controlled gold mineralization in all three rock types may possibly add to present reserves and contribute to maintaining a lower stripping ratio for the Deep Sulfide Target in the main mine area.	A major fault zone trending north from the western margin of the Langley stock to the plant site area is present. Trachyte porphyry is intruded along and within the fault zone and spreads out as a sill-like mass west of Strawberry Creek. Faulted Deadwood and pC rocks are also present and form the basis for possible strataform and fault-controlled mineralization. Several +.030 OPT Au surface samples outline this fault zone. However, no drilling has occurred along the trace of this favorable fault zone. Four surface samples exceed .10 OPT Au, one of these is 1.9 OPT Au.	Conduct in-fill surface sampling and more detailed geologic mapping of this zone west of the Dakota Maid oxide pit in order to better identify possible follow-up drill sites. Possible IP/Resistivity
HOODOO TARGET	5	TRACHYTE PORPHYRY, DEADWOOD FM., pC ROCKS. Fault-controlled mineralization in trachyte porphyry, Deadwood Fm, and along the trachyte-pC contact zone. Ore additions here, like the Langley Extension, would contribute to lowering the stripping ratio for the Deep Sulfide Target in the main mine area.	Widely-spaced (200' x 200') condemnation drilling conducted during 1987 in this area showed the presence of low to high-grade gold intercepts along a NW trending mineralized fault zone extending from this area toward Anchor Hill, essentially open at both ends. Mineralized drill intercepts range in depth from the surface to 600', in thickness from 5 to 215', and in grade ranging above a cutoff of .02 OPT to 75' averaging .144 OPT.	Conduct in-fill surface sampling + more detailed geologic mapping in order to identify more refined drilling targets. This work is aimed at defining up-dip extensions of fault-controlled gold mineralization in order to define ore contributions in this area now considered as waste in the Deep Sulfide Target area.

FOLLOWING TARGETS ARE UNDRILLED IN WHICH ONLY CURSORY SURFACE SAMPLING/ MAPPING HAS BEEN CONDUCTED CONDUCTED

TABLE 2
PROPOSED EXPLORATION TARGETS - GILT EDGE PROJECT

AREA/TARGET	PRIORITY	GOLD MINERALIZATION TARGET	GEOLOGIC BASIS	PROPOSED EVALUATION
NORTH STRAWBERRY EXTENSION		DEADWOOD FM. Oxide & sulfide gold mineralization.	Northward extension of North and NE structures responsible for mineralization identified in the North Strawberry and Anchor Hill targets coincide in this area. Cursory surface sampling in this area identifies a zone of +.030 OPT Au. Strong surface alteration has also been identified by Dick Nielsen in mapping conducted last fall. Oxide as well as sulfide gold mineralization is possible in this area, possibly as strataform bodies within the Deadwood Fm.	Surface sampling and geologic mapping to identify drilling targets.
RATTLESNAKE EXTENSION, RUBY RIDGE AND BUTCHER TRENDS		TRACHYTE PORPHYRY AND DEADWOOD FM. Oxide & sulfide gold mineralization	The northern portion of the NE trending Rattlesnake fracture zone is only poorly identified. Faults alteration patterns and surface gold anomalies take on a stronger NW trend in these areas. Cursory sampling shows some areas of +.030 OPT Au anomalies which can now be explored because of recent land acquisitions in those areas.	Surface sampling and geologic mapping to further identify drilling targets.
GOLDEN CREST		DEADWOOD FM. Strataform and fault-controlled oxide and sulfide gold mineralization.	Area of unrecorded previous mining northwest of main mine area. This area is currently poorly understood. No sampling or drilling has occurred here in recent history. Although exposures are rare, the Deadwood Fm. is the postulated host for past production. Projection of NW trending structures in main Gilt Edge area coincide with area of Golden Crest. Thermal alteration mapped in this area where Deadwood is exposed as small "windows" through horneblende trachyte sill.	Surface sampling & more detailed mapping needed to identify drill targets. Amount of cover in area may lend itself to IP/resistivity survey techniques to help identify target.

TABLE 2
PROPOSED EXPLORATION TARGETS - GILT EDGE PROJECT

AREA/TARGET	PRIORITY	GOLD MINERALIZATION TARGET	GEOLOGIC BASIS	PROPOSED EVALUATION
HOODOO RIDGE		DEADWOOD FM. and pC ROCKS. Brecciated rocks marginal to the Hoodoo quartz trachyte porphyry intrusive.	Totally unexplored area east of main Gilt Edge area. Newly acquired in 1988, our land position now affords the opportunity to explore Deadwood Fm. and pC rocks intruded by this northwest trending feeder. Strong alteration was mapped by Neilsen in both the quartz trachyte and the Deadwood Fm. and pC rocks marginal to the intrusive.	Surface sampling and follow up geologic mapping necessary to define drilling targets.
GOLDEN CREST EXTENSION		DEADWOOD FM. Strataform and fault controlled gold mineralization.	A large area of thermal and hydrothermal alteration was mapped by Tom Patton late last year extending northwest from the Golden Crest Mine area. The most intense alteration was seen in Deadwood Fm. rocks exposed in small 'windows' through sills of hornblende trachyte. Because of these relatively small areas of exposed Deadwood, the few +.030 OPT Au surface samples are restricted in this area. However, this large area of widespread alteration and anomalous gold geochem deserves much more attention in order to define possible structural controls on mineralization.	Surface sampling and follow up geologic mapping necessary to define drilling targets.

Continuation of Phase I - Compiled 3/28/88 - 200' centers

Proposed Drill Holes - 1986 Sulfide Z

3/30/88

SECTION	EASTING	PROPOSED DEPTH	AZ/BEARING	PRIORITY	TARGET
44,400 N	125,705	300'	— —	2	fault, Єdg, pЄ
44,500 *	126,460	600			
44,400 N	127,070	1325' (1100' min)	— —	1	Ttp, fault, Tbxa
"	127,270	800	— —	2	Ttp, fault
"	127,470	700 3125	— —	2	Ttp, pЄ contact zone
44,600 N	125,580	600	— —	2	Єdh, Єdg, pЄ fault
*	126,850	900			
	127,000	1400 (1100 min)	— —	1	Ttp, Tbxa.
	127,200	800	— —	1	Ttp,
	127,400	600 3400	— —	2	Ttp, fault zone, pЄ contact
44800 N	126,000	500	— —	2	pЄ, fault
	127,000	1400 (1200 min)	— —	1	Ttp, fault (deep)
	127,300	950	— —	1	Ttp
	127,500	650 3500	— —	2	Ttp, fault, pЄ contact
45,000 N	125,990	400	— —	2	pЄ, Creek fault
	126,900	1350	— —	1	Ttp
	127,100	1250	— —	1	Ttp
	127,300	1050	— —	2	Ttp, pЄ Contact
	127,500	850 4900/[illegible]	— —	2	Ttp, pЄ Contact
45,200 N	125,980	650	— —	2	pЄ, DMFZ, Creek fault
	126,890	1500	— —	1	Tqtp, Tbxa, Ttp, CFZ,
	127,080	1400	— —	1	Tqtp, Tbxa, Ttp, CFZ
	127,230	1000	— —	1	Ttp, CFZ.
	127,950	900	— —	2	Ttp, pЄ contact
	127,800	650 [illegible]	— —	2	Ttp, fault,

...OTION	EASTING	PROPOSED DEPTH	AZ/INCLIN. ~~BEARING~~		PRIORITY	TARGET
45,400 N	125,805	300	—	—	2	Є, pЄ, Ttp, Creek fault
	126,000	A) 1000'	—	—	1	Є, pЄ, Ttp, DMFZ, Creek fault
		B) 1500'	E-W,	-75°		Ttp, DMFZ, Ttp/Tgtp margin
	126,200	A) 1200'	—	—	1	Ttp, DMFZ, pЄ contact
		B) 1200'	E-W,	-75°		Ttp, Tgtp/Ttp margin, Tgtp min.
	126,810	600'	—	—	1	Tgtp FZ
	127,330	1250	—	—	1	Ttp, RFZ, pЄ contact
	127,640	950 5300	—	—	2	Ttp, NW faults, pЄ contact
45,600 N	125,775	450	—	—	2	Ttp, pЄ contact, Creek fault
	126,000	1200'	—	—	1	Ttp, Creek fault
	126,170	1400'	—	—	1	Ttp,
	126,370	1500'	—	—	1	Tbxa, Tgtp margin, Tgtp min.
	126,610	1200'	—	—	2	Tgtp min.
	126,910	700'	—	—	2	Tgtp FZ
	127,450	1550'	—	—	1	Ttp, pЄ Contact, NW fault zone
	127,650	750' 8750	—	—	2	Ttp, pЄ Contact
45,800 N	125,875	1050	—	—	2	Є, pЄ, Ttp, Creek fault
	126,235	A) 700	—	—	1	Є, pЄ, possible fault zone
	"	B 1250	—	—	1	" " " " "
	127,500	1200	—	—	1	Ttp, pЄ contact, RFZ
	127,740	700 4200	—	—	2	Ttp,

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SECTION	EASTING	PROPOSED DEPTH	AZ/BEARING	PRIORITY	TARGET
45,950N ★	126,295	950	— —	1	Є, pЄ, Tbxa. possible NE fault
46000 N	125,750	850	— —	2	Ttp, Є, pЄ, Creek fault
	126,095	800	— —	2	Є, pЄ
	~~126,295~~	~~950~~	~~— —~~	~~1~~	~~Є, pЄ, Tbxa, possible NE fault~~
	127,450	1050	— —	1	Ttp,
	127,650	750	— —	2	Ttp, pЄ contact
	127,900	650 5050	— —	2	Є, pЄ, RFZ
46,100 ★	126,400E	1100	— —	1	Є, pЄ,
46,200	126,065	250	— —	2	Є
	126,820	550	— —	2	Є, pЄ
	127,175	1050	— —	1	Ttp, UHFZ
	127,435	700 2550	— —	2	Ttp
TOTAL	54	49,475	(916/hole)	@$25/ft	1.24 } w/o CONTINGENCY
#1 only	26	30,175	(1160/hole)	@$25/ft =	.755 }

PROPOSED 1988 DRILL TARGETS - GILT Edge EXTENSION Project

		N	E	ELEVATION	DEPTH	BEARING	INCL.	COMMENTS
	1	44600	27900	5300	600'	—	-90°	Test pЄ/Ttp contact
HOO DOO AREA	2	44700	27700	5360	400'	—	-90°	Same
	3	44600	28100	5260	600	—	-90°	Same
	4	44800	28000	5310	800'	—	-90°	Same
	5	44850	27700	5395	600'	—	-90°	Same
	6	49500	27700	5350	800'	—	-90°	Same
	7	44400	27600	5405	600'	—	-90°	Same, Geochem
					4400'			
EAST OF LANGLEY STOCK	8	44250	27050	5550	500'	N90E	-45°	Test Langley (Tqtp)/Ttp, Ttp/pЄ contacts, west dipping fault
	9	43950	26950	5560	500'	N90E	-45°	Same as #8
	10	43800	27050	5450	800	—	-90°	Test Tqtp/Ttp contact
	11	43700	26750	5435	600'	—	-90°	Test Tqtp/Ttp contact, pЄ contact, west dipping fault
	12	43800	26800	5475	1000'	N90°E	-90°	Same as #8+9
					3400			
WEST OF LANGLEY	13	43650	26150	5235	600'	—	-90	Test geochem anomaly
	14	43875	25150	5295	400'	—	-90°	Test geochem anomaly, south dipping Flt.
	15	44050	25450	5275	600'	—	-90'	Test Tqtp/pЄ contact, strawberry Creek Flt
	16	44075	25250	5325	600'	—	-90'	Test geochem anomaly
	17	44200	25475	5280	570'	N90W	-45°	Test Tqtp/Tbxa/Ed contacts, strawberry Creek Flt.
	18	44100	25050	5345	600'	—	-90°	Test geochem anomaly
					3370			
WEST OF DAKOTA MAID	19	44600	26000	5312	600'	—	-90°	Test pЄ/Tqtp contact near King Cabin
	20	44750	25900	5325	400'	—	-90°	~~Geochem~~ admin, bldg sight
	21	45000	25200	5400	600'	—	-90°	Geochem anomaly
	22	45300	25000	5450	600'	—	-90°	Geochem anomaly, Ed/Ttp contact
	23	45500	25100	5455	600	—	-90	Geochem anomaly in Ttp.
					2800'			
				TOTAL	13,970			

Survey of sites 5/9/88

	N	E	ELEV.	Proposed Location N	Proposed Location E
DM	45595.5	26629.5	5629.7	45,600 $^{4.5}$	126610 $^{17.5'}$
~~C. Point~~	~~45794.6~~	~~[illegible] 27000.4~~	~~5630.2~~	~~45,800~~ $^{5.0'}$	~~127,000~~
Valley	45594.7	26922.6	5603.6	45,600 $^{5.5'}$	126,910 $^{12.6'}$
Sunday	45197.9	27073.6	5620.9	45,200	127,080
Crusher	45603.4	27618.0	5530.8	45,600	127,650

N	E
45,800	127,500
45,800	127,740
44,500	126,460
44,600	126,850
44,600	127,000
44,600	127,200
44,800	127,000
"	127,300
45,000	126,900
"	127,100
45,200	126,890
"	127,080
"	127,230
45,400	126,000
"	126,200
"	126,810
"	127,330

CONTINUATION OF PHASE I - Compiled 3/28/88 - 200' CENTERS

PROPOSED DRILL HOLES - [illegible] SULFIDE Z

3/30/88

SECTION	EASTING	PROPOSED DEPTH	AZ/BEARING	PRIORITY	TARGET
44,400 N	125,705	300'	— —	2	fault, Cdg, pC
*	126,460	600			
44,400N	127,070	1325' (1100 min)	— —	1	Ttp, fault, Tbxa
"	127,270	800	— —	2	Ttp, fault
"	127,470	700 3125	— —	2	Ttp, pC contact zone
44,600N	125,580	600	— —	2	Cdh, Cdg, pC fault
*	126,850	900			
	127,000	1400 (1100 min)	— —	1	Ttp, Tbxa,
	127,200	800	— —	1	Ttp,
	127,400	600 3400	— —	2	Ttp, fault zone, pC contact
44800N	126,000	500	— —	2	pC, fault
	127,000	1400 (1200 min)	— —	1	Ttp, fault (deep)
	127,300	950	— —	1	Ttp
	127,500	650 3500	— —	2	Ttp, fault, pC contact
45,000 N	125,990	400	— —	2	pC, Creek fault
	126,900	1350	— —	1	Ttp
	127,100	1250	— —	1	Ttp
	127,300	1050	— —	2	Ttp, pC Contact
	127,500	850 4900	— —	2	Ttp, pC Contact
45,200N	125,980	650	— —	2	pC, DMFZ, Creek fault
	126,890	1500	— —	1	Tgtp, Tbxa, Ttp, CFZ,
	127,080	1900	— —	1	Tgtp, Tbxa, Ttp, CFZ
	127,230	1000	— —	1	Ttp, CFZ,
	127,450	900	— —	2	Ttp, pC contact
	127,800	650	— —	2	Ttp, fault,

SECTION	EASTING	PROPOSED DEPTH	AZ/INCLIN. BEARING	PRIORITY	TARGET
45,400 N	125,805	300	— —	2	Є, pЄ, Ttp, Creek fault
	126,000	A) 1000'	— —	1	Є, pЄ, Ttp, DMFZ, Creek fault
		B) 1500'	E-W, -75°		Ttp, DMFZ, Ttp/Tgtp margin
	126,200	A) 1200'	— —	1	Ttp, DMFZ, pЄ contact
		B) 1200'	E-W, -75°		Ttp, Tgtp/Ttp margin, Tgtp min.
	126,810	600'	— —	1	Tgtp FZ
	127,330	1250	— —	1	Ttp, RFZ, pЄ contact
	127,640	950 5300	— —	2	Ttp, NW faults, pЄ contact
45,600 N	125,775	450	— —	2	Ttp, pЄ contact, Creek fault
	126,000	1200'	— —	1	Ttp, Creek fault
	126,170	1400'	— —	1	Ttp.
	126,370	1500'	— —	1	Tbxa, Tgtp margin, Tgtp min.
	126,610	1200'	— —	2	Tgtp min.
	126,910	700'	— —	2	Tgtp FZ
	127,450	1550'	— —	1	Ttp, pЄ Contact, NW fault zone
	127,650	750' 8750	— —	2	Ttp, pЄ Contact
45,800 N	125,875	1050	— —	2	Є, pЄ, Ttp, Creek fault
	126,235	A) 700	— —	1	Є, pЄ, possible fault zone
	"	B 1250	— —	1	" " " " "
	127,500	1200	— —	1	Ttp, pЄ contact, RFZ
	127,740	700 9200	— —	2	Ttp.

SECTION	EASTING	PROPOSED DEPTH	AZ/BEARING		PRIORITY	TARGET
45,950 N ★	126,295	950	—	—	1	€, p€, Tbxa, possible NE fault
46000 N	125,750	850	—	—	2	Ttp, €, p€, Creek fault
	126,095	800	—	—	2	€, p€
	~~126,295~~	~~950~~	~~—~~	~~—~~	~~1~~	~~€, p€, Tbxa, possible NE fault~~
	127,450	1050	—	—	1	Ttp,
	127,650	750	—	—	2	Ttp, p€ contact
	127,900	650 . 6050	—	—	2	€, p€, RFZ
46,100 ★	126,400E	1100	—	—	1	€, p€,
46,200	126,065	250	—	—	2	€
	126,820	550	—	—	2	€, p€
	127,175	1050	—	—	1	Ttp, UHFZ
	127,435	700 2550	—	—	2	Ttp
TOTAL	54	49,475	(916 / hole)		@ $25/ft	1.24 } w/o CONTINGENCY
#1 only	26	30,175	(1160/hole)		@ $25/ft =	.755

GEOL.

LACANA GOLD INC.

Gilt Edge Project
Lawrence County, South Dakota

1984
Prospecting & Reconnaissance
Program

Lacana Gold Inc.
2005 Ironwood Parkway
Coeur d'Alene, Idaho

Cole H. Carter
April, 1985

TABLE OF CONTENTS

SUMMARY & RECOMMENDATIONS

Exploration on and near the Gilt Edge property defined areas with ore grade mineralization and established the viability of soil sampling in the area. One hundred forty rock samples and 130 soil samples were collected. The soil samples were collected from two grids. The east Gilt Edge grid had good contrast of values, and anomalous areas were delineated. An area with >1.0 ppm gold in soil was drilled, and hole RGE 84-8 averaged 0.029 oz/ton gold over 140 ft. The rock in the hole is unoxidized. Values on the Anchor Hill soil grid are significantly lower than on the east Gilt Edge grid. No follow-up work has been done on the Anchor Hill grid.

Rock samples were collected from pits, trenches, and outcrops, and encompass all rock types in the area. A gully 300 ft east of the Ora Bella adit exposes Cambrian and Precambrian rocks in contact with the Tertiary trachyte porphyry. The five samples from the gully averaged 0.035 oz/ton gold. Union Hill is 1000 ft north of the Sunday Pit, and 13 samples were collected from the area. Enrichment of gold is evident on Union Hill, but it appears that the potential for mineable tonnage is limited.

Hoodoo Gulch

Numerous old workings and prospect pits are located east of the main Gilt Edge area in upper Ruby Gulch. Not all of this land is controlled by Lacana; however, strongly mineralized samples were collected from some of these unleased claims. For example, a dump sample from an old shaft assayed 2.16 oz/ton gold, and a nearby eight foot chip sample assayed 0.142 oz/ton. On the Portland claim, a 10 ft chip sample assayed 0.134 oz/ton. The good gold values and the proximity to Lacana-controlled land dictate that Lacana should make a concerted effort to acquire these claims. Additional work is needed in upper Ruby Gulch, and the geologically similar Butcher Gulch needs to be prospected.

Beach-Fahewi?

Several anomalous rock samples were collected at Anchor Hill. These samples further define ore grade mineralization near the contact of the hornblende diorite and the sanidine rhyolite intrusive. Angle hole RGE 84-5 was drilled to test the contact mineralization; however, significant near surface mineralization was not encountered.

Only a small portion of the land west of Strawberry Creek was examined. Sampling did not indicate significant enrichment in the small trachyte bodies west of Strawberry Creek, so mineable tonnages would have to be hosted in the Deadwood Formation and the hornblende diorite. Thirty-one samples were collected. Gold values range up to 0.06 oz/ton for the widely spaced samples. Much additional prospecting is required in the area, and old workings should be mapped and sampled.

Exploration around Gilt Edge should continue during the 1985 field season. Priority should be given to securing uncontrolled land in upper Ruby Gulch and to systematically exploring the area. A few days of surface mapping and sampling would further define the anomalous areas and should be undertaken as soon as possible. Underground sampling and mapping is largely contingent on the accessibility of the shafts, so a brief examination is necessary prior to planning an exploration program.

Other areas warrant additional work. The gulch east of the Ora Bella should be mapped and sampled. Additional rock samples should be collected from the southwest part of the East Gilt Edge soil grid. The large area west of Strawberry Creek (which includes the Zelda claims) will take several weeks of mapping and sampling to fully evaluate. No additional work at this time is recommended for Union Hill or Anchor Hill.

Introduction

Much of the land peripheral to the main Gilt Edge area has not been prospected in recent time, so a program was launched during the 1984 field season to sample and map these areas. One hundred forty rock samples and 130 soil samples were collected during the 18 day program. Rock samples were fire assayed by Strawberry Hill, and pulps from 38 of the samples were sent to Bondar-Clegg (Denver) for check assays. The correlation coefficient for gold assays at the two labs is 0.999. Rock sample locations are based on topography with triangulation checks where possible. Areas with numerous pits and trenches were surveyed with a Brunton and Hip Chain. Brief descriptions of the individual samples were recorded on the sample cards but are not included in this report. Previous reports expound upon the geology and lithologies of the Gilt Edge area, and they should be consulted for additional geologic information.

Samples from two soil grids were collected in areas of poor rock exposure. The "B" horizon was sampled, and lithologies of the rock chips encountered while collecting the samples were recorded. Distances between sample stations were measured by Hip Chain and adjusted for slope correction. Soil samples were analyzed by Bondar-Clegg by the methods shown in Appendix 1.

In order to accommodate the sampling on existing topographic base maps, the sample locations are shown on six maps that are included in this report. Discussions of these areas follow. Many areas were not examined during this limited program, and additional mapping and sampling is necessary to evaluate the potential for economic mineralization in the areas with anomalous samples.